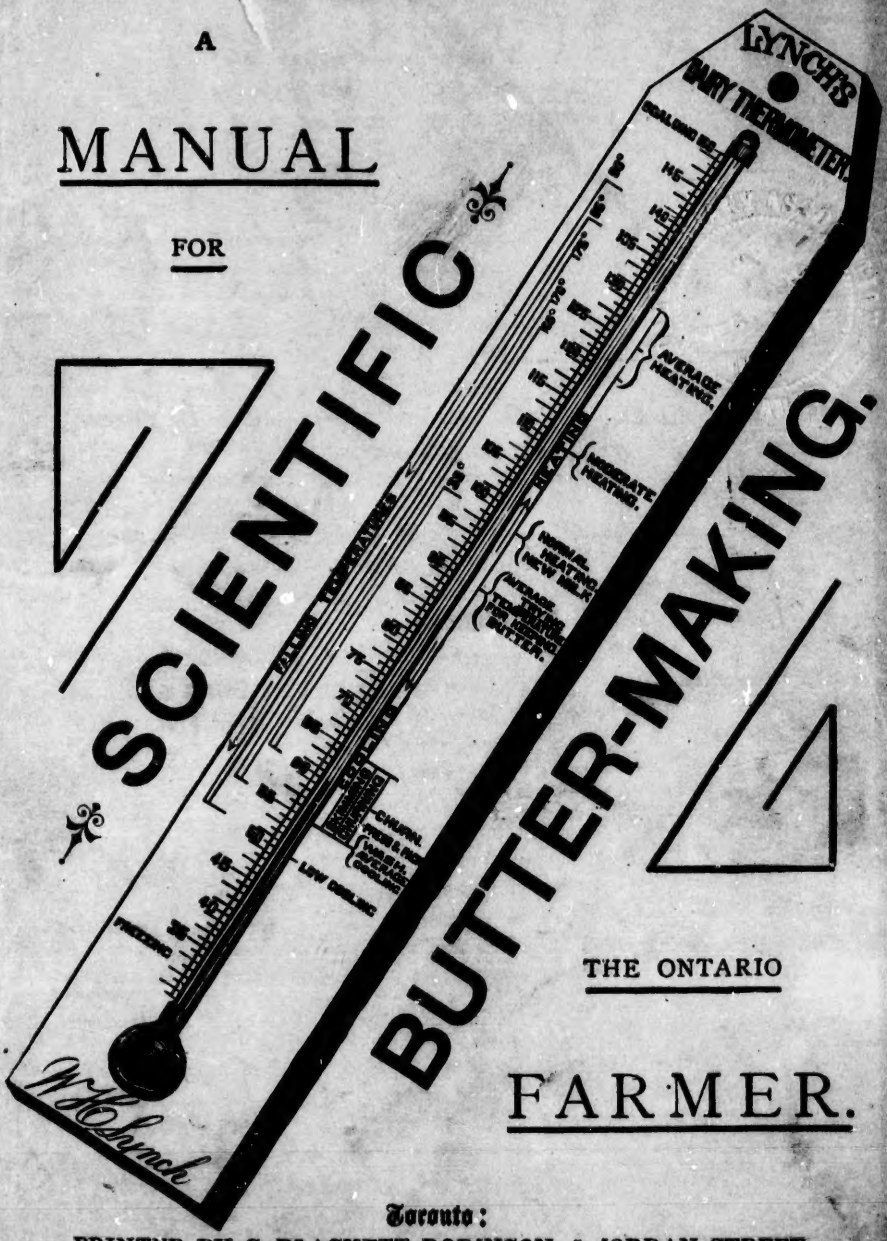
A

MANUAL

FOR

SCIENTIFIC BUTTER-MAKING.



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1883.

Can. Lynch, William H. 1

SCIENTIFIC

BUTTER-MAKING.

BY W. H. LYNCH,

Editor ALPHA, *Danville, Eastern Townships, P. Q.*

Printed by Order of the Legislative Assembly.

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PREFACE.

Says Prof. Arnold:—"The art of butter-making is an intricate operation. Its success depends upon a succession of little acts, each one of which is liable, when not performed aright, to alter the whole character of the production. The correct performance of all these little acts involves an acquaintance with the properties of milk which the present extent of practical and scientific knowledge renders it difficult to acquire." This was said or published in 1879. Since that time there has been some advance, at least in practical knowledge, that makes it less difficult to acquire the art of butter-making. But the position taken by Prof. Arnold, while from his point of view a right one, is not the position taken by the writer of this MANUAL. Butter-making is largely a mechanical operation, and in some measure is made more difficult or less difficult according to the mechanical aids in use. For instance, were one to attempt to follow out the whole process, according to the simplest directions possible to be given, by always using the hand to determine temperature, how much more difficult would be the process, and how much more uncertain the result, than would be were the operator to make intelligent use of a thermometer.

Again, the carrying out of each of the different processes, does not necessarily involve an acquaintance on the part of the operator with the knowledge of the peculiar qualities or properties of the material worked upon—milk, cream or butter. The process may be followed out mechanically, the operator imitating, as it were, the practice of others who employ the scientific method. For instance, care and cleanliness may be practised without knowing how important the effect upon the product; advantage may be taken of a falling temperature in which to raise cream, without appreciating the interesting and somewhat involved theories that support the practice; butter may be washed in a granulated state without thought of the, in many respects, great advantage in the practice.

Yet it is true that a knowledge of the why and wherefore of any process enables the operator to follow it out not only with more pleasure, but with more advantage, certainty and profit. While good results may be obtained by carefully following out a practice that has been acquired without a knowledge of the theory involved, many advantages would come of understanding the theory. The operator would be able to provide against exceptional cases which sometimes occur, that otherwise would be difficult to meet. A more rapid advance toward perfection would be made by one possessed of both theory and practice.

Prof. Bell said on this subject:—"It is *desirable* that all persons connected with the prosecution of the dairy business, should have acquaintance with the principles on which success depends."

These considerations are the key to the character of this Manual. Practice and theory are both given, but separate. Practice is given first, because of its higher practical value, because it has a practical value in and by itself such as theory does not possess. Theory is given as something that has great value and will be of great, even *practical* service, but as a supplement to practice. Both are given in the plainest and simplest manner.

It is in place to quote from an article read by Prof. Bell last year at the Eastern Dairymen's Convention at Belleville:—"The marvellous advance in cheese-making is chiefly owing to the employment of scientific methods of investigation, namely, accurate observation and logical deduction, tested and confirmed or corrected by experiments." Speaking of the result of the establishment of Dairymen's Associations, he said they have given us "the views of gentlemen of large experience and scientific attainments, and have sent from factory to factory the most skilled and ablest practitioners to instruct on the best and most improved methods of manufacture and proportion of material, thus insuring a uniformity of quality, which alone can form the basis for a national reputation."

A word or two as to the way to make the best use of this MANUAL. The author has so arranged the subject-matter that the reader will find the practical instruction in the first pages of the book, and the philosophy of the science farther on. An *Appendix* has been added, in which the subjects have been elaborated, and in which may be found many valuable and helpful suggestions, from all available sources. But the arrangement of the work allows of its being read in another way than in regular course, and, doubtless, to great advantage. It will be most profitable to read or study it topically. First, glance over the *Table of Contents* and get an idea of what the book contains, and of what is of the first or most immediate importance. Choose a topic, learn as much as possible about it, and *put it into practice at once.* For instance, the subject of *Churning* may be taken up. In *Table of Contents* the reader will find that his subject is treated of, in practical and philosophic order, on pages 6 to 9, 20 to 24, and 128 to 136. Something will be found also bearing upon the subject, under the heading of *Churns*, pages 36 to 38, and 146 to 148.

It is believed that the Canadian butter-maker will be able by the study of this work, to correct any faulty method that he or she may have adopted, and to acquire a practice that will be advanced enough to be termed scientific. It is not expected that the advance will be made in a single change. Step by step advantage will be taken of the knowledge of each improved process, and the theory itself will be gradually mastered. It is advised that the operator study the process first and adopt it at once in its most important and essential features. For instance, in the churning process let a beginning be made by *stopping the churn in time.*

It is advised, too, that the butter-maker of Canada adopt the policy, which is certainly the most economic, of procuring dairy supplies, such as tubs, salt, etc., only of the *best quality*, and of fitting up the dairy with any and every mechanical aid available which will make the work easier and more satisfactory in result. An effort has been made in this MANUAL to help the butter-maker also in the choice and selection of supplies and mechanical appliances.

The APPENDIX will show that the successful butter-makers, as well as the writers on dairy subjects, all of whom stand as authorities, support the scientific method.

Let the writer's faith in the intelligence of the Canadian farmer and butter-maker be justified by the early improvement of an industry that is becoming in importance second to none. Let the result of the study of this little and very practical work prove that they are not over-sanguine who have faith in the Canadian farmer,—his intelligence, willingness to learn, and disposition to advance.

W. H. L.

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SCIENTIFIC BUTTER-MAKING.

Science is a gathered knowledge of what is known and can be learned about a subject. A scientific process is one that makes the most of what a knowledge of the subject teaches. There is a great advantage in an advanced, or scientific method, over primitive ways, or an unscientific method. In following out known and well-proved, definite rules of working is had a guarantee of definite and satisfactory results.

There is science in what is known to-day about the management of milk, and the production from milk of butter, or cheese. There are established rules of working, more or less known, that will uniformly give certain, definite results.

The science of butter-making, in its practical bearing, is not difficult to learn. The ground is covered by plain rules; the process is a mechanical one, and mechanical helps make it easier. Plain instructions for the employment of simple appliances may embody a scientific method. Ordinary intelligence, care, and neatness are the necessary personal qualifications for working out the rules.

The philosophy of the scientific processes may be made plain enough to be learned by any intelligent person. While the study of the philosophy is not absolutely necessary to the making of a good quality of butter, it is a study that is interesting and profitable, leading to a better understanding of the various processes.

THE SCIENTIFIC METHOD, OR PROCESS.

Milking.

Milking Preparations.

Cleanliness is the most important thing in milking. The milk-vessels and pails require to have been thoroughly scalded immediately after previous use, ready for use again. The place when the milking is done should be properly ventilated, the floor or ground upon which the cows stand, should be clean and dry. This will require, if in a stable, that straw, or some other absorbent, be spread under the cow's feet to prevent spattering.

Now the cow is ready to welcome the milker who presents himself with clean hands, and by a kindly word and a gentle patting gains her confidence. Before bringing the milking-pail to the cow the milker gives the udder a good brushing with a cloth, or the hands. It is taken for granted here that the cow has all along been properly bedded and carded, and that previous milkings have always left the udder clean, and in healthy condition. Failure in this respect may make it necessary to wash the udder and teats. If so let it be done with clean water—never with milk—and the udder be wiped dry before milking. To milk clean, dry teats with clean, dry hands is not only cleanly but easier and more pleasant.

The Operation.

The milker, provided with a good and solid stool for a seat, draws himself close up to the cow, his right side towards her head. If his pail does not hold a full milking, the

milker has within reach, vessel room enough to hold all that the cow will give, so that he need not rise before he is done. The left arm is held near the leg of the cow, as a protection for the pail should the cow raise her foot. The milking is done with both hands, the right hand taking one forward teat and the left hand taking the opposite hind teat, "changing teats often enough to relieve the pressure in the different parts equally." The milk is now drawn very quickly and quietly, care being taken to draw, or "strip," all that there is.

"When the cow is nearly milked, the milker's hand, as it grasps the teat, reaches up a little above the teat so as to press the milk down through the valve or contraction at the upper end of it, and every time the milk is pressed out of the teat, the milker pulls down on it, not with a jerk, but gently. The omission of this operation leaves a part of the milk in the tubes." (Arnold.)

The milking is usually done by using the hands alternately, gently squeezing out the milk with the speed and force that experience will show to be most agreeable to the cow, keeping up an almost continuous stream. When towards the end of the operation it is necessary to reach the hand above the teat, as above directed, the alternate motion may sometimes with advantage, give way to co-incident motion—both hands moving together. Which motion is the best will depend much upon the peculiarities of the udder and teats of the cow. The thorough milker will study these peculiarities, adapt himself to them, decide upon the best plan, and then always milk the same cow in the same manner.

Care of the Milk.

Our wise and capable milker as soon as possible, with no unnecessary loss of time, carries the milk to the nearest and most convenient place, where in a pure atmosphere, the milk may be emptied, either into a carrying, heating, or milk-setting vessel. If for convenience, or other economical reason, the milker while milking in one vessel allows milk to stand close at hand in another vessel, the precaution will be taken to have this second vessel covered from the surrounding air. The atmosphere of the milking-place is not likely to be the most suitable for aëration. Knowing that the full range of falling temperature is required in the cream-rising process, the wise milker does not allow the freshly-drawn milk to stand and cool any longer than absolutely necessary, before getting it into the next vessel that receives it,—into the carrying, milk-heating, or milk-setting vessel, as the case may be.

Other Points.

Other characteristics of a good milker are system and regularity. Care is taken to milk at a regular hour, which has been chosen so that the intervals between milkings will be as nearly as possible evenly divided. Each milker undertakes to milk only as many cows as can be well attended to, which is not usually more than ten; and these are milked in regular order, each cow in her own turn. A few cows may sometimes be milked when standing loose in open field or yard, but if there are any risks of the cows annoying each other or of being from any cause fretted and disturbed, they are securely attached in their respective places to be milked.

Setting the Milk for Cream-Rising.

From the Milking-Place to the Milk-Room.

The milk is carried to the milk-setting room with the least loss of time. It is then at once strained carefully, through a linen or wire cloth, into the milk-setting vessels. If a strainer-milking pail has been used in milking, it will not be necessary, of course, to strain again in the milk-room. Where the milk is aërated or heated, it is to be done at this stage.

Setting in open Milk-Vessels.

If air is depended upon for cooling the milk while setting, the variations of the temperature of the atmosphere must be taken into account in determining the depth at which

the milk should be set. A general rule may here be laid down. *The cooler the air, the greater may be the depth; the warmer the air, the shallower may the milk be set.* It is always an object to have the temperature of the milk-room somewhat low, and as unvarying as possible; it is especially desirable where air is the cooling agency. A pure atmosphere is always an essential in the milk-room; this is especially important where open vessels are used.

Where water or ice are used for cooling the milk, the question of depth is not dependent upon the variation in the temperature of the air.

Setting in Closed Milk-Vessels.

The advantage of a closed vessel is that the impurities in the atmosphere are excluded from the milk. But before milk be closed against the atmosphere and ventilation, in such a way that its own impurities cannot escape, it is necessary that the milk be purified. This may be done by aëration—exposing the milk to pure air, or by heating it, to expel or kill the germs. The advantage would be in favour of heating, since heating would more effectually purify the milk, and increase the range of falling temperature. Aëration would lower the temperature of the milk, which in itself is not desirable.

Where milk is set in closed vessels, air is never depended upon for cooling, except the milk has been heated to a high temperature before setting. Where pure cold water is used, milk may be set in closed vessels without heating. The water may be used to seal the cover from the outside atmosphere and yet ventilate the milk. The water, being colder than the milk, condenses and takes in the odours that escape from the milk.

Heating the Milk.

Heating milk before setting it is not commonly practised, nor is it absolutely necessary. All that can be said for it is that it has certain advantages in the process, and that it is better for quality's sake to heat before setting than to practise low cooling, or cooling below 55° to 50°. If good results in cream-rising are obtained by setting the milk at its own temperature, without low cooling, then heating may be dispensed with. If heating be employed, let it be no higher than necessary, the range being from 100° to to 140°. *The more defective the milk, the higher the heating.* If the milk is in a normal condition the extreme temperature may, both for sake of saving in labour and quality, be avoided. A good average will be from 110° to 130°.

The heating may be done by setting the vessel containing the milk in a vessel containing water, the latter being heated in the most convenient manner.

Best Range of Temperature.

With the present knowledge of the effects of temperature upon the melting point of butter, it is not easy to give a definite rule for placing the range of temperature. A suggestion may, however, be given. The process demands lowering the temperature to 55° for the purpose of washing. If this change, or fall, of temperature is not sufficient, it will be better to take advantage of higher temperatures before cooling lower. That is, it will be better to heat above 90° or 100°, than to cool lower than to 55°. Ten degrees above 100° will give more advantage to the process than ten degrees below 55°. How high to heat before cooling below 55° it is not easy to say. The experience of the operator and circumstances will best determine. The rule will be to keep, as far as possible, within safe limits both in heating and cooling, and yet obtain for the process every necessary advantage from cooling and heating. If making butter for a far market, give its melting point, or keeping quality, the benefit of any doubt; which means to cool or heat less rather than more.

Aërating Milk.

Aëration is not so necessary where heating is practised as otherwise. The higher the heating is carried, the less necessary it is to aërate the milk. Where heating is not em-

ployed, it is better to aërate the milk, *where it can be done without cooling it too much before setting.*

Milk is aërated by exposing as much as possible of its surface or body to a pure atmosphere. It is done in many ways—by pouring it from one vessel to another, by stirring it, etc. The disadvantage of both heating and aërating milk, is the trouble involved. Butter-makers will always spare themselves any unnecessary labour.

Cooling the Milk.

The first part of the cooling, when the difference between the temperature of the milk and the cooling agency is greatest, will be the most rapid. This is well, because the milk, if kept long at a high temperature, will quickly sour. But when the milk is down to from 75° to 65°, it is better to cool slowly; that is, it is better that the temperature should change slowly and be *constantly falling* than that it should fall too quickly and then *stand unchanging* at its lowest point.

Where air is depended upon as a cooling agency and is variable in temperature, it is not easy to accomplish this. The general rule given may be kept in mind. Where heating or aëration is employed, it is not so difficult to do. Where milk is heated to 120° and above, and more or less of the germs it contained are killed, it will keep a longer time at high temperature and so be allowed to cool more slowly. Where the air of the milk-room is the cooling agency and it is high, say up to 70°, the advantages of heating before setting would be greater. Aëration will cool the milk a few degrees and it will thus loose some of the advantage of the falling temperature, but it will allow the milk to be more slowly cooled afterwards.

Avoid too low cooling. It will be found that keeping quality and "delicacy of flavour" suffer from low cooling. For this reason spring water or running water are better than ice, and the moderate employment of heat is desirable whenever it saves the necessity of cooling too low.

Warming Up and Cooling.

Where the temperature has been lowered too quickly and to a very low point, it may happen that the cream has almost ceased to rise, and there is yet some cream held in suspension near the top, on its way up. This case may be met, if the milk-vessel is suitable, by applying heat—water or steam—at the bottom, and raising the temperature a few degrees. This warms the milk, and the cooling which follows sends up more cream. In this way the effects of a falling temperature are availed of indefinitely. The heating must be done *gradually*, not too fast, and *only a few degrees.*

How long Milk may Set.

The length of time that will be required to raise the cream, will depend on the means used in setting for cooling. Where advantage is taken of the help of artificial heating or cooling, cream will rise in twenty-four, or even twelve hours. Setting milk in the most primitive way it will require thirty-six or forty-eight hours to rise. Cream may be raised in twelve hours, without loss in quality, and with great gain in saving of time and labour

Skimming.

The rule for skimming is when the cream ceases to rise, or when the cream is up that may be taken off to advantage and profit. Just what length of time will be required will depend upon the conditions. No good can come either to the cream or the skim-milk by standing together after the cream has risen.

Where twice skimming is practised, this rule applies, of course, only to the second skimming.

The methods of skimming or removing the cream, are various. One plan is to use a sieve-skimmer. This plan is followed when milk has been set shallow and in open vessels. The time for skimming is when the cream is of a consistency that it will not flow back

when the finger is passed through it. The second plan is to use a scoop-skimmer. This is to be preferred over the former. By its use more of the milk will be lifted, but there is no objection to this. The milk nearest the cream is likely to be more or less rich in cream, and it is economy to jar it with the cream. Another plan is the use of a tunnel-shaped cup, sometimes with an up-right handle. A now common plan is to draw off the cream by means of a faucet, in a manner provided for by the vessel used. The two latter plans are usually adopted when milk has been set deep, in larger bodies, and cooled by water. In this case the cream will be of a softer consistency and thinner. Here again it will be well sometimes to take a little of the cream along with the milk. The faucet is sometimes objectionable. For instance, when the milk and cream become unduly mixed, when the sediment at the bottom of the vessel is drawn out and mixed with cream, or when it is not so constructed that it may be thoroughly scalded.

How much Cream to Skim.

The first cream that rises being the best in quality, and the last being comparatively poor, it is not always an object to raise all the cream. Where a fine article is desired, it will be found that the last cream which rises depreciates quality even more than it increases quantity. How much to take off will depend somewhat upon what use is to be made of the skim-milk. Cream adds to the value of skim-milk for some purposes, as, for instance, for house use or cheese-making. For feeding purposes cream does not add much value to the milk, and it would be poor economy to leave it in the milk when the latter is to be fed out.

A good plan is to skim the first rising of cream, taking off about three pounds of butter to one hundred pounds of milk. This butter, if properly manufactured, would be of a superior quality. A second quality of butter could be made of the rest of the cream, or it could be left in the milk, only, of course, where the use of the milk afterwards would be such that cream in it would add materially to its value. The making of best qualities of butter would be a good plan to follow only by those butter makers who by careful attention to all points, succeed in making a good quality of butter. Those who are likely to injure the quality of butter, by mismanagement later on, may just as well, or better, get all the cream possible, for where the profits do not depend on quality, the only chance for them is quantity. For instance, it would be no object to improve quality in creaming at expense of quantity, and then by leaving butter-milk in the butter, by over-working or over-salting, or other faulty process, to injure the quality.

Care of the Cream.

Ripening.

As very few dairies are large enough to make it an object to churn each milking separate, it is usually necessary to churn different skimmings together. Where this is the case the following points are important: Never keep in separate vessels the cream that is being accumulated for a single churning; always put the cream for a whole churning in a single vessel, which must be large enough for that purpose. A failure to do this will result in loss of quantity. As each skimming of cream is added to what has been put in before, let the whole be well stirred together. It is always well, and is sometimes necessary, to stir the cream occasionally between the times of adding new lots, especially towards the last when there is greater difference between the old cream and the fresh skimmed. After the last cream has been added, the whole should stand well mixed until it has become equally "ripened." The time required for this will be twelve hours, at the average temperature, or 60°. At a higher temperature it will not require so long a time; at a lower temperature it will take longer. This is necessary in order to have the cream equally ripened. If not equally ripened, some of the cream will be farther advanced than the rest, and will churn first leaving some of the cream in the butter-milk.

If, therefore, it be desired to churn sooner, the cream may be heated up, and when ready, cooled to the proper temperature. If it be an object to delay the churning, always

let the cream stand at a lower temperature than the average, until ready for churning, when it may be warmed up to the necessary degree.

The Hon. Harris Lewis advises that a small quantity of salt be added to the first cream that is put in the cream-holders. The object of this practice is to make the cream keep longer and in better condition.

How to Warm and Cool Cream.

Always warm and cool cream gradually. Sometimes the churn may be cooled or warmed by cold or hot milk so as to make a difference of a few degrees in the cream. Cold or warm milk may be added to the cream, where the cream needs to be made thinner to lower or raise the temperature. Ice or hot water are objectionable. If more than this is required, let the vessel holding the cream be set in another vessel containing water, cold or heated, as the case may require. Or, if it be more convenient, place a bottle, or other vessel, containing cold or warm water in the cream till the desired temperature has been obtained.

Sweet Cream for Churning.

Though cream should be somewhat advanced towards souring, or ripened, it is not necessary that cream be sour, either to churn it or to get a first quality of butter. Cream should have some age and airing. This may be obtained before skimming if it remains long enough on the milk ; but it will usually be better to give it a little time to age and ripen after it has been skimmed. If the cooling be slow and *not low*, so that it will be from twenty-four to thirty-six hours raising, the cream may be churned soon after it is skimmed. If milk has been heated up before setting and cooled down to a moderate temperature, it may be churned soon after being taken from the milk, even though it be less than twenty-four hours rising ; but if milk be set without previous heating and raised in a short time by reducing it to a very low temperature, the cream should stand, after being skimmed, twelve hours or more before churning.

Sour Cream for Churning.

There is no objection to cream being sour before churning if it be not too far advanced. Where different skimmings are mixed to be churned at one time it is even better that the cream be sour, as it is more likely to get evenly ripened. The slightest souring is the best ; there can be no object to keep it after it has first turned except where the different skimmings have been mixed and the time the whole has stood together has not been sufficient to equally ripen it. In this case the fresh cream, if well mixed, keeps back the souring of the old cream until the whole has reached a like condition. After the cream has sufficiently soured, the longer it is kept the poorer the butter. The sooner it is churned after it has turned the better, in all cases, for *quality*.

Churning.

Temperature of the Cream.

Quality of the butter and the time it will take to churn are dependent upon temperature. It is not easy to name the degree of temperature that will always be the right one, The best that can be done is to give what will guide the operator in the exercise of the judgment.

The Average Temperature.

The *average* temperature may be said to be 60°. The *average range* of temperature may be said to be from 55° to 65°. The lower the temperature within the average range the better for quality, but the longer it will take to churn : the higher the temperature the quicker will the butter come, but the higher it is above what is just right the poorer will be the quality.

The Rule for Temperature.

The rule then is *to churn as low within the average range as will bring the butter within a reasonable time.* Quality always takes precedence over time. General conditions to be taken into account in determining churning temperature will be treated of in order.

The Rule for Time.

Under usual conditions the average or "reasonable" time may be said to be from twenty-five to forty-five minutes. Where the conditions are especially favourable or unfavourable, the average may be extended in either direction, and the average put from fifteen minutes to one hour. There is no need of a longer range.

Conditions Affecting the Rules for Temperature and Time.

The main conditions are: (1) The character of the cream—some cream churns more easily than other cream; and cream churns harder the longer the cows have been milked. (2) The condition of the cream—its degree of advance toward sourness or its stage of ripeness. (3) The churn and churning—how much agitation the cream gets. (4) The temperature of the cream and place of churning and the change of temperature while churning. To meet the first condition, if unfavourable, the operator must expect to churn a little longer, helping the matter within safe limits by churning at a higher temperature. The second and third conditions ought to be brought under control and made satisfactory. Let the scientific method be availed of to get the cream in a right condition, and to choose the right kind of a churn, one that will agitate the cream sufficiently but not so much as to injure the grain. The fourth condition requires, too, exercise of judgment. The agitation of the cream has a tendency to raise the temperature, but the place in which the churning is done has its influence. The temperature of the churning is usually such as to cause the cream to get warmer; but there may be times when the temperature of the cream may be lowered by the surrounding air even while the cream is being agitated; this must be noted and provided for. As a rule the operator will have to provide for the temperature rising while the churning is being done. The rule for this is simple: Where the temperature is likely to rise while churning, cool the cream accordingly; where it is likely to fall, warm the cream acccordingly.

Summer and Winter Churning.

There are two conditions that are different in winter and summer: (1) The condition of the cream in winter will be such that it will be hard to churn it. (2) The temperature of the churning-room will be lower. Owing to this is required a rule for a temperature somewhat different in winter from summer. The winter temperature will be higher; the average may be 58° to 60° in summer and 60° to 62° in winter.

Preparing the Churn.

The churn must be well rinsed with water before putting in the cream. If it be desired to raise the temperature of the cream, use hot water to rinse the churn; if it be necessary to cool the cream rinse the churn with cold water. Only a slight change of a few degrees may be made in this way.

When necessary to change the temperature of the cream it may be partially if not wholly done by the addition here made to the cream. Follow the rule already given. If cream is too cold add warmer milk or water; do not over-fill the churn. The capacity of most churns is about half full. Churns without dashers are better when even a little less than half full.

Putting the Cream in the Churn.

To churn without injury to the grain of the butter, and to provide for proper washing of the butter in the churn, the cream requires to be *not too thick.* While it is almost

certain to be too thick, there is no risk of it being too thin. It is a safe rule always to add to the cream what will thin it. Skim-milk may be added. It is at this stage that the temperature must be attended to, and the colouring put in.

Colouring.

Where an artificial colour is required use the best in the market. For quantity follow the directions sent with the colouring, always *keeping on the safe side of using too little rather than too much.* An under-colour will always pass ; an over-colour that will be at once recognized as artificial will be worse than no colour.

Colouring is best applied to the cream just before churning. It cannot be so well incorporated with the butter afterwards, and the process of working it in evenly would require so much kneading of the butter as to injure the grain.

The Operation of Churning.

Start the churn slowly at the beginning, increasing gradually until the ordinary motion has been attained. Let the ordinary motion be moderate rather than fast, and let it be regular and uniform. When the butter has come the speed may be reduced to about half. The churning may now be advanced till the butter has reached a granulated or pebbled form. The temperature at this time, if every condition is favourable, will be from 58° to 60°. It is now lowered to about 55°. This may be done by putting in cold water. If it be an object to save the butter-milk without being too much diluted with water, it will be necessary to strain off most of the butter-milk before putting in the water, or cold skim-milk may be added. Care must be taken not to stop too soon, nor to advance the operation too far. *As soon as the butter has all come and is gathered enough to make it possible to strain off the butter-milk without carrying the butter off in the waste, the churning should be stopped.* At this stage the grains will be about the size of pin heads, from that to grains of wheat. This process is of first importance, and butter-makers will consult their best interests by adopting it. With a little experience in this improved process the old way of gathering in large lumps would be forever abandoned. The churning process is now done and the butter is ready for the next and a very important process.

Washing.

The churning has been stopped when the butter is yet in fine grains. The butter-milk should now be drained off and the butter washed in its hard, granulated state, first with cold water and afterwards with brine.

Manner of Washing.

The method to be employed will depend upon the sort of churn used. Churns with stationary body are not well adapted to the process ; but where there is lack of mechanical appliance, experience and skill must make up for the lack. If the churn be stationary, like the dash churn, and if in its construction there be no provision for the washing process the following method may be adopted. After the temperature has been lowered and the butter has been enough advanced, the contents of the churn may be poured out into a strainer or seive that will allow the milk to pass through and leave the butter behind. Water or brine may now be poured on and allowed to pass through, leaving the butter, and carrying off all foreign matter. This must be repeated until the water runs off clear, and the pure butter remains.

If the churn is one with a movable body, and there is provision for the washing process, the work will be much simplified. In this case the butter remains in the churn while it is being washed. The butter-milk is drained off through a strainer. Cold water and brine, in turn, are successively poured in, the butter gently agitated in the usual way, the water or brine then drained off in the same manner as the butter-milk.

Little practice will be required to enable one to do this as easily as to gather in the old way into a larger lump, which makes it necessary afterwards to work out the butter-milk at the expense of the grain of the butter, and at the risk or certainty of leaving shells of cream globules, caseine or membraneous matter in the butter, to depreciate both the eating and keeping quality of the butter.

Pure Water.

The water should be quite fresh, clean, and pure. If only a little defective it may be remedied by making it into good brine by the use of pure salt. There are other ways of purifying it, but if absolutely impure it will be better not to wash the butter but to let it drain off as much as possible while in its granulated form and then to press and salt it, carefully working out as much as possible of the butter-milk. This process will be likely to involve over-kneading and more or less injury to the grain, but of the two evils —butter-milk or a broken grain, the broken grain is to be preferred. Indeed, butter-milk left in the butter, with or without broken grain, is a worse evil than the use of moderately impure water, if the washing be done quickly and thoroughly with brine while the butter is in fine grains.

Heating stands perhaps first as a means of purifying water. Where there are solid impurities in the water it is well to strain it while pouring it into the heating-vessel. After the water has been thoroughly boiled, it may be removed from the fire and cooled, of course always in a pure atmosphere. As the quantity required for washing the butter need not be large, it need not be a troublesome work to heat the water, especially if a suitable heating vessel be provided. In any case the *absolute importance* of having clean and pure water calls for any necessary trouble there may be to obtain it, and the trouble taken will be more than repaid in the result.

Removing Butter from Churn.

There are several ways of taking the butter from the churn. The most convenient way may be employed, provided it removes the butter clean from the churn without breaking the grain or making it stick to the churn, and does not involve injurious contact with the hands. When the brine begins to run off clear, the draining off may be stopped and the butter may be lifted out with a sieve-dipper. Another plan. The last brine and the butter may all be dipped out, or poured out, into a strainer or sieve, as before described, and the brine allowed to drain away from it. Or, lastly, after the last brine has been drained off, the butter may with a little care be lifted out with a wooden ladle.

Washing the Churn.

Rinse well with cold water so that none of the butter grains will be sticking to the churn, then thoroughly scald with hot water. If the churn has a movable body the agitation of the hot water will be sufficient to clean it. Drain off the hot water, remove cover of churn, to leave it as open as possible, and leave it to evaporate. Wash the cover and other separate parts of the churn by themselves in the usual way. Churns washed in this way are cleaner than if washed imperfectly by the use of hot waters and a cloth.

Pressing and Salting.

Hand Contact.

The hands must not be allowed to come into contact with the butter. For this reason mechanical aid is necessary, even as it is necessary to churn the butter. If the quantity is small a wooden bowl and ladle may serve the purpose. A clean, level table—never use for other purposes—and a roller will do very well; but a suitable butter-press, or "butter-worker," would make a saving in labour and give better results.

Preparing the Press.

The articles used should be thoroughly scalded with boiling water, or steam, and afterwards rinsed with cold water. Let this be done immediately before using.

Preparing the Butter.

Where the butter has been accumulating in a butter-holder for some time, being the product of several churnings, one or two precautions are necessary. With a wooden ladle give the whole quantity a gentle stirring or mixing so that the whole will be well mixed while yet in the granulated form. If there is no perceptible difference, in colour or otherwise, between the different churnings this mixing is less necessary. Drain off the brine and give the butter a quick washing with water. Where the pressing follows each churning the above instructions are not applicable.

Temperature.

Let the butter be as nearly as possible to 58° to 60° when pressing and salting it. The best plan to arrive at this temperature is to have the working-room at a right temperature. If the working-room is too warm cold water may be utilized to help matters; if too cold, there is no objection in starting the butter when it is a little warmer—a very little. There should be as little variation as possible from the right temperature in pressing butter, and in no case should it vary more than a few degrees. Experience will soon show when the butter is on the one hand too soft, and on the other hand too hard.

Salting.

Use a sieve in salting. When the proper quantity of salt has been determined, it may be sifted upon the butter so that it will be evenly added. This provides for having it more evenly mixed and with less pressing.

If the butter contains a good deal of water when the salt is added, some of the salt will run off in the pressing. From 25 to 50 per cent. of the salt will thus run off, and this must be provided for by the operator. It is important that the quantity of salt left in the butter be just enough to give it the right taste for the market for which it is intended. This makes it necessary for the operator to give the matter of quantity considerable attention, so that observation and experience may give always a good result.

Pressing and Salting Separately.

It has been a common practice to press all the water from the butter and afterwards to work in the salt. This practice has nothing to commend it and is referred to only to suggest that it be discontinued where in vogue. It requires more working of the butter, and at a time when the butter is more or less dry, or when it is most affected by the strokes of the power used. If the salt itself be dry it makes matters worse. The sharp corners of the salt cannot but have the effect of cutting the grain of the butter.

Pressing and Salting Simultaneously.

The better plan is to make each stroke serve a double purpose; *i.e.*, to eliminate the water, incorporate or evenly mix in the salt and give the butter its solidity and compactness. In this case if the butter when removed from the churn is comparatively free from water, it is as well to throw a quart or two on the butter in the worker. The salt may now be spread on the butter by *sifting it through a fine seive*, so as to put it in as evenly as possible. Let it now be subjected to the most direct pressure possible. Avoid any "rubbing, grinding, or sliding motion." Let every stroke be such as to do the least injury to the grain and to tell the best in working out the water and mixing in the salt. When the water has been pressed out, and the butter is of the right consistency, the salt should be so thoroughly incorporated that the pressing may be discontinued. Make use of the

help of a sponge or cloth. It does not require greater skill nor make the work harder, while it will be likely to save the grain. When water is observed standing on the butter, while the butter is being pressed, the sponge or cloth applied to the water will absorb it and save so much pressing. Do not work out too much brine. It must not be too dry or too spongy.

Single vs. Twice Pressing.

The Hon. Harris Lewis adopts the practice of pressing and salting at a single working. It has the advantage of convenience in doing the work at once and there is a chance that the time for the second manipulation may not be so favourable as the first. The other method has its special advantages.

Prof. Arnold supports the second plan, or that of interval pressing and salting. He says: "As soon as ready the salt should be evenly incorporated, always doing it with the least possible labour, then the butter set away for six to twelve hours for the salt to dissolve, and then worked (pressed) again with a single working. Some dairymen are in the habit of working but once, and packing as soon as salted. This treatment will not spoil good butter, but when the finest quality is desired and the butter is to be long kept, the practice is not advisable. When the salt is added to the butter it absorbs the water of composition and leaves the butter a little porous. A short second working makes it more solid. A firkin which will hold 100 pounds of butter worked once will hold about 102 pounds of butter worked twice. The second working should be barely enough to press the mass firmly together and get out a part of the brine. To remove all the brine makes it too dry, but not to work out any, leaves too much in and the texture a little spongy."

Both plans are supported by good authority and may be included in the scientific method. If the butter is for immediate consumption or a local, quick market the first plan is good. The Hon. Harris Lewis sells in such a market. If for export it will be safer and better to adopt the plan of twice pressing.

Kind and Quantity of Salt.

The salt should be of the purest quality. Get the very best, at whatever price. There is no economy in using salt of a quality inferior to what may be procured.

The quantity of salt will depend upon the market for the butter. One half to three-fourths of an ounce will do for quick markets, and one-quarter ounce additional where butter is intended for export. Where the butter is dry when salted, the salt may be weighed with exactness, but where the plan is adopted of salting the butter simultaneously with wet pressing, it will be necessary to increase the quantity to make allowance for what salt will run away in the brine. In this case the quantity will be required of from one and one-quarter ounces to one and one-half ounces to the pound.

Packing.

Preparing the Tub.

Soak the tub, if it be of wood, with strong brine for two or three days. Pour out this brine and fill the package with boiling hot brine. Let it stand till cold, and the package will be ready for use.

Filling the Tub.

The following directions apply to the packing of tubs with air-tight covers: Pack the tub solid and quite full. Cover the butter, which should be even and smooth, with a piece of fine muslin. The cloth should be say an inch larger than the top of the butter. Wet it with the brine and lay it over the butter. Press the edge of the muslin neatly down between the outside of the butter and the inside of the tub. Put on the head of the tub and fasten it down. Turn it upside down and bore a hole in the bottom. Pour on enough pure, strong brine to fill the tub, and let the tub stand till the brine fills

it quite full. Let the plug stand loosely in the hole, to exclude the light, while the tub is soaking in the brine.

Prof. Arnold advises covering the bottom of the tub with a layer of salt from half an inch to an inch in depth, and leaving room for another layer on the top of the muslin. The Hon. Harris Lewis advises packing into the tub without a layer of salt being added, either on the bottom or top. There is an advantage in the plan of Harris Lewis, in that the net weight of the butter may be more rapidly arrived at, possibly without removing the butter from the tub. The other plan provides better for surrounding the butter with what will exclude the air and make it keep better. If the salt-layer plan is adopted it is better when the butter is to be shipped to foreign markets. Skilful butter-makers and careful packers may, doubtless with a view to profit, dispense with the layers of salt.

Where the tub being packed has not a cover that is air-tight, the brine must of course be poured on the top, filling the tub as well as can be done, and the cover then fastened down.

Butter should be packed at a temperature of from 58° to 60°.

Marketing.

The butter-maker who has adopted the advanced or scientific method, will have the best basis for a good market—first quality of product. Let the butter be packed in new tubs, previously well prepared, and let its appearance be as pleasing as a little time and even money, well expended, will make it. Let the name of the maker be marked upon the package, also any other particulars, the residence, the date of its make. Even a fancy name for the dairy will be a matter of value to represent dollars and cents in the future. If packed in rolls, let name, or some brand, be put either upon the stamp, or printed upon the wrapper put around the butter.

Sell direct to consumers if near by, otherwise sell only to a responsible and reliable firm, and upon condition that the butter shall go into the market not lumped in with a lot of inferior stuff, but with a chance to stand upon its merits. Let it not be sold as a job lot, but to fill an order that may be repeated, supplying to-day a market that may to-morrow have a further supply of just as good as what preceded it. Let the butter-maker ask his agent, the butter-dealer, to stand responsible for the quality of the shipment, the maker engaging upon his part to stand by the dealer.

One more word about marketing butter. Make a butter that will keep if there should be no market for it; but if there be a fair market do not hold the butter for a rise. The non-speculative policy is, in the long run, the wisest policy for the producer. When the speculator has disorganized the market, and prices are temporarily below reason, the dairy-man may "hold on." This is exceptional; and for a permanent policy that is wise, the sell-in-season policy is to be commended.

PHILOSOPHY OF THE SCIENTIFIC METHOD.

Cleanliness and Purity.

Risks of Contamination.

While milk, cream and butter are peculiarly sensitive to odours or taints of any kind, the animal source of milk makes it unusually subject to chances of contamination.

The health of the cow, what she eats or drinks, the kind of treatment, will affect the milk for good or bad, even before it is drawn from the udder.

The surroundings of the milk while it is being drawn are always more or less unfavourable to cleanliness. Milk itself, when set, will give off that which will make a pure atmosphere unfit for other milk.

The souring or decay of milk comes from the growth of germs within itself, and from seeds floating in the atmosphere. Not only when new, but in its after existence, as a raw material in process of manufacture, or as a manufactured article—butter—it maintains its extreme sensitiveness to impure odours.

Importance of Pure Milk.

Impurities in milk affect unfavourably not only the value of its products, as articles of diet, but the *very processes that give the product.* For instance, the drinking of bad water by the cows, by causing the milk the sooner to sour, hinders the rising of the cream, and the same cause will make more difficult and unsatisfactory the churning of the cream.

Thus while it is, as it were, doubly important that milk be pure, there are to be guarded against multiplied chances of its getting contaminated.

Milking.

Characteristics of a Good Milker.

The operation of milking, simple and humble as the work may be, requires some personal qualifications of a high order, and some preparation. A thoroughly good milker will be both wise and kind; besides being intelligent, he will have in his own breast not a little of the "milk of human kindness." He will be possessed of both judgment and skill. When seeking the favour of that gentle domestic creature, the cow, the good milker must be in a presentable condition, at least so far as having a pleasant look, a kindly voice, and clean hands. Indeed, he will require to have his finger nails closely pared—closely enough, at any rate, not to hurt the teats of the cow. The well-qualified milker will be not only cleanly in person, he will be cleanly in habit. He will give attention to the condition of the cow, of the place where the milking is done, and the general care of the milk until it has been removed to the dairy, or given into other hands.

Pure Milk.

To have the milk possess its full value it should reach the dairy as pure as it leaves the udder. To secure this, more than ordinary care is required, owing to the at first necessary association of the milk with the animal producing it, and its surroundings. Water, dirt, or hairs dropping from the body; dirt spattering up from the floor; odours

from the milking-place or the cow; all these must be provided against combining to defile the milk. To provide against impurities, it is required that the cow be milked in as dry, clean, and airy a place as possible; that the udder, also the rear portion of the cow, be in a clean and dry condition; that the necessary exposure, during the time of milking, of the milk to the air and dirt of the milking-place, be of the smallest surface of milk and the shortest time possible.

Quantity and Quality of Milk.

Many little things that seem trifling have an effect upon both the quantity and quality of the milk, not only of the one immediate milking, but of the future yield of the cow. Frightening or hurrying the cows, harsh treatment, will make the yield smaller and defective in quality. Pain, hunger, cold, fear, disappointment when expecting habitual messes, or general discomfort, any or all of these will keep back the flow of milk. Leaving milk in the udder when milking, means so much loss of the very richest portion of the milk, and, further, has the effect of drying up the cow, so lessening the future yield. Too long a time between milking means a loss in quality, because the longer the milk remains in the udder the poorer it is in cream. Irregular milking tends to dry up the cow.

General Requirements.

The sluggish, timid nature and dependent disposition of the cow must be favoured. All her movements must be in natural, quiet order, so as to be of the least disturbing character. She needs such kind care and gentle treatment as will conduce to her best comfort. Especially when her milk is being drawn must she be in the highest state of contentment and repose. Nothing sudden or unusual should be allowed to attract her attention. She must not be kept waiting too long to be milked, and while being milked she should enjoy the operation.

Temperature.

Effect of Temperature on Milk Germs.

Different degrees of heat and cold have an effect, and a varying effect, upon the germs which milk contains naturally, and also upon the taking in from the air of the germs that cause souring and decay. There is a temperature (98°) most favourable to the taking in by milk of germs, and to their growth. A higher or lower temperature is increasingly unfavourable to the taking in of germs, and checks their action or kills them. Extreme heat kills, extreme cold checks the action of the germs.

Effect on Cream-Rising.

The rising of cream is dependent upon temperature. A high temperature is favourable to the rising of cream; in a low temperature cream moves sluggishly. A changing temperature, if it be a falling one, is most favourable for the cream to rise. The rapidity of change affects the quantity of pure cream. If it be too rapid, the quantity will be deficient—the quality of the cream will be thin and mixed with milk. The artificial heating or cooling of cream may be employed to produce good results, or the contrary.

Effect on Quality.

Extreme temperatures are injurious to milk and its product. Milk may be heated too high or too low, not only for quantity but quality, both eating and keeping quality, of butter.

Relative Temperature of Milk and Surrounding Air.

Milk will give off its odours, or take in new odours, according as it is warmer or colder than the air surrounding it.

In Cream-Keeping and Churning.

The temperature of cream affects its keeping and its condition for churning. Upon the temperature of the cream, while it is being churned, depends more or less the time of churning, the grain and colour of the butter, its eating and keeping quality. The difference of only a few degress is marked in its effect.

In Washing and Working.

The proper washing of butter (upon which perhaps more than any other one thing in the whole process depends keeping quality) requires regard for temperature. Here, again, a very slight change is marked. If too warm, the butter sticks together and gathers before it has been washed. If too cold it will not gather at all, and so does not advance enough to be washed without loss.

A slight difference in temperature of butter while it is being worked, salted and packed, affects its grain, its compactness, and its condition for keeping.

Butter when made has a certain *melting point* of temperature. That degree will be its limit for well keeping. A too low temperature, on the other hand, not only affects the flavour of butter, but *its keeping quality afterwards at a high temperature.* For instance, it is injured by being kept on ice.

Milk-Setting.

Depth.

There are three main conditions that are affected by depth. (1) The distance the cream has to rise. (2) Temperature. (3) Cost of utensils and labour.

(1) It is evident that the less space cream has to move through, other things being equal, the shorter time it will take for it to find its way to the top. The movement of cream is slow, because of its slight difference in gravity and because of the obstructions which it meets in its upward motion. If there were no other conditions, it would be well to set milk very shallow, but as it is there may be gain in sacrificing to other advantages the advantage of shallow setting. (2) Temperature is one of the most important influences affecting the rising of cream. High and low temperatures respectively affect both the speed which the cream makes in its upward movement and the time milk will keep sweet, or in a proper condition for cream-rising. The advantages of temperature are generally got at a depth greater than would be desirable if depth alone were depended upon. (3) Economy of space, saving in cost of vessels and in labour, are secured by depth. The larger or deeper the body of milk the better, so far as this third condition goes.

In determining how large bodies of milk to set, the natural rule would be to favour the third or economical condition, so far as it is possible, and yet secure the best advantages found in the two other conditions. This would lead to setting deep, within limits. The better the means that may be utilized to take advantage of the influence of temperature, the farther, for the sake of economy, a departure may be made from shallow-setting with its advantage, or, in other words, the deeper the milk may be set.

A consideration of the effects of temperature is necessary to a rule for bulk, body, or depth in milk-setting. To get much benefit from temperature, the milk must not be cooled too fast to get the full benefit of a falling temperature. On the other hand, if milk is cooled too slowly it will sometimes sour before the cream has risen. Heating may be employed as a means to at once give a wider range of falling temperature and to

make the milk keep longer sweet while slowly cooling. Again, water may be employed as an agency for cooling, and its advantages will allow deeper setting than could be practised where air is the cooling agency. The effects of temperature and the utilization of water as a cooling agency will be more fully treated of in other and separate connection.

The Temperature Best for Cream-Rising.

A High Temperature.

A high temperature is better than a low one. Cream rises because it is lighter than milk, but the difference between the gravity of the two is very slight. Anything done to increase that difference will hasten the rising. Anything that will lessen the difference will retard the rising. Heat will increase and cold will decrease the difference. Fats expand more with heat and contract more with cold than water does. Cream is mostly fat, milk is mostly water. This being true, it follows that cream is relatively lighter than milk as the temperature becomes higher, and relatively heavier as the temperature becomes lower. Therefore, the higher the temperature, other things being equal, the lighter is the cream relatively, and the quicker it will rise. The lower the temperature the heavier is the cream relatively and the slower will it rise.

There is another reason why a high temperature is more favourable than a low one for cream-rising. Milk becomes more fluid-like, or rarified, as it gets warmer, and more solid and sluggish as it gets cold. Cream will move upwards more freely, meeting with less resistence, when the milk is warm and rarified, and will move with more difficulty and find greater obstacles when the milk is cold and sluggish.

A Falling Temperature.

A falling temperature is better than an unchanging temperature. Water, or milk, is a better conductor of heat than fat, or cream, and when milk is cooled its watery part is affected before the cream and is the first to contract. The cream thus becomes relatively lighter than the milk because of the more rapid shrinkage of the milk.

A Rising Temperature.

The writer is not yet able, from experience or experiment, to speak of the comparative value of a rising temperature for raising cream. J. M. Jocelyn, Dairy Professor, of Quebec, believes that a rising is better than an unchanging temperature. His theory is that either the contraction or expansion of the milk or cream particles causes a disturbance which favours the upward movement of the cream. He illustrates the theory by the well-known effect of the fanning of grain to separate the heavier grain from the lighter chaff. If this opinion be sound, and the experience and judgment of Mr. Jocelyn is good support of it, we must rank the rising temperature for cream-raising as next to the falling temperature. In other words, a changing temperature, in either direction, is better than an unchanging one. In such case the double advantage of heating milk to afterwards cool it will be apparent. The writer, since learning the views of Mr. Jocelyn, has had no opportunity to experiment with a view to settle the point to his own satisfaction. He is inclined to believe that the opinion advanced is correct.

Heating and Cooling Milk.

The object in cream-rising is : *first*, to separate all the cream from the milk ; *second*, to leave the skim-milk sweet, or in a condition to be of highest value for use, feeding or cheese-making ; *third*, to manage with little cost, time and labour.

These objects require mainly that the milk be kept as long as possible sweet, and that a wide range of falling temperature be secured, being the most favourable conditions for raising cream.

Keeping Milk Sweet.

Mil. contains within itself germs that grow and cause the milk soon to sour, and there are in the air germs that milk will take in and which will cause decay. Heating and cooling milk counteract these influences, but in different ways. A high temperature kills the germs, a low temperature arrests their action. Milk if heated to a high enough temperature, and the air excluded, or cooled to a very low temperature and kept there, will remain a long time sweet.

Obtaining a Falling Temperature.

A falling temperature may be obtained by allowing the milk to set in an atmosphere colder than itself. This fall of temperature is limited by the ordinary conditions under which milk is set. There is usually a considerable fall, say to 85° before the milk is set. Sometimes the atmosphere of the dairy, or milk-setting room is at an unduly high temperature, say 60° to 70°. There may be obtained in ordinary setting, therefore, only 15° or 25° of fall. Artificial means may be employed here to increase this range of falling temperature. Water, applied to the vessel containing the milk, may be used to cool the milk, more speedily and to a lower temperature than can be attained by air. Water is a better conductor of heat, it is in summer colder than the air, and always of a more uniform temperature. By the use of water, therefore, milk may be artificially cooled to the end of obtaining a longer range of falling temperature. Again, the milk may be heated up to its original warmth, or higher, and then allowed to cool, or be cooled, thus giving a greater fall of temperature. Thus to obtain a falling temperature, the artificial means may be employed of heating and cooling, one or both.

Changing Temperature.

The object of heating or cooling milk, and causing it to pass through a range of different degrees of temperature, is not to improve the intrinsic quality of the butter. So far as the needs of the butter grain go, if the milk could be allowed to cool down gradually to temperate, and remain there, nothing better could be asked. Any change of temperature before or afterwards, if it has any effect on the butter, will be in the direction of the disorganization of the butter grain, and unfavourable. The object that is had in view in securing a wide range of temperature, is for the mere sake of process, the obtaining of the cream, and afterwards the butter. Therefore the aim will be to make as little change as possible to secure to the process the advantage of change, and to make that change where it *will least affect the grain itself.* It will also be the aim of the operator never to cause a change of temperature for the sake of advantage in the process that will do any marked injury to the quality of the butter.

Safe Limits of Temperature.

Milk may be cooled to so low a temperature that it will cease to throw up cream, and where it will have an injurious effect upon the colour, taste and keeping quality of the butter. On the other hand there is a high temperature to which milk may be heated, that will have a marked unfavourable effect on the quantity of cream and quality of butter. The range of temperature between these two opposite points, is sufficient to make it no object to approach too near these unsafe limits.

Safe Cooling Limit.

It is difficult from what seems at present known, to fix the safe cooling limit. A great deal has been said and written of the good and evil effects of cooling that has not taken into account the whole question as here presented. It is evident that the limit must at least be fixed on the warm side of freezing or 32°. There are two facts that will give a rule of operation. While in heating the advantages to process are increasingly

less, the unfavourable effects on quality of butter are increasingly greater as the cooling goes on. The rule would be to stop between freezing and the lowest of the high temperatures that may be said to be absolutely necessary,—to stop as near as possible to the latter (55°), and as far as possible above the former (32°).

Safe Heating Limit.

The outer limit in heating for safety against *marked injury* is short of *scalding*. There is in scalding milk risk of lessening the quantity of cream that will rise, and of injuring the quality of butter. It is doubtful if the effects of scalding are practically so unfavourable as those of freezing. Butter made from whey that has been heated to 170°, to cause the cream to rise quickly, is a better article than butter made from whey that has been cooled quickly down to 60°. The practice has been followed of scalding not only milk, but cream. If whey and cream stand so high heating, milk will stand it better. It would appear that a safe limit would be found anywhere short of scalding. To say that such a temperature would be a safe limit, does not mean that it would be an object in ordinary cases to heat to that degree. Ordinarily there would be no necessity for approaching that temperature, as a lower temperature would usually serve all requirements. If, however, there are any defects in the milk that cannot be cured at a lower temperature, it would be well to avail of the advantages of heating, and to *approach* scalding. For instance, flecks in butter are cured by heating; the butter would be worse with the flecks than with the high heating necessary to cure the defect.

Best Time for Heating and Cooling.

The newer milk is, the better it stands a change of temperature. Butter-fat is protected while it is in cream by the sac or pellicle that encloses it. This may be seen by noting the point at which butter will melt, and it will be seen that cream may be subjected to a much higher temperature, without melting the butter afterwards produced. This pellicle, as it gets older, becomes a less effective protection. It churns or breaks easier as the cream gets older, approaches sourness. The need of utilizing the effects of a falling temperature demands that milk be set as soon as possible, and before time is lost by the milk cooling and getting older before setting.

Milk for Transportation.

Milk fresh drawn and in its normal condition, is in the very worst condition for transportation. Placed in closed vessels and subjected to agitation, the difficulty is increased. The agencies of heat and cold may here be utilized. Heating will kill the germs which the milk contains, and then it will carry either in closed vessels or in a pure atmosphere. Cooling to a low temperature will check the action of the germs and favour its transportation. When destination has been reached, artificial heating may be employed before setting. The cooling may sometimes be done during transportation, if milk be carried in open vessels and well aërated in a pure atmosphere.

How to Heat and Cool Milk.

In accordance with the theory of a falling temperature, there are two rules for changing temperature in milk. Milk should be *heated at the bottom* and *cooled at the top*. The movement of the cream is, of course, upwards. If, therefore, the cold be applied at the bottom, the cream, as it rises, goes from cold to warm; that is, its movement would be in a rising temperature, the opposite from the effect produced by cooling. If, on the other hand, the cold be applied at the top, the cream, as it rises, goes from warm to cold; that is, its movement would be in a falling temperature, or in a line with the effect produced by cooling.

Milk may be heated by air, hot water or steam. Hot air is only in a limited degree suitable for heating milk; hot water and steam are the desirable agencies. Milk may be

cooled by air, cold water or ice. Air is too variable, and sometimes too slow an agency; ice must be used wisely, or it will cool too fast or too low; cold water, if properly applied, is comparatively uniform in temperature, and if judiciously applied, may be used to cool quickly enough, low enough, and as gradually as is desired.

Heating vs. Cooling.

Heating milk before setting gives a wider range of falling temperature; it destroys germs in the milk, and will allow it to stand at a higher temperature, for a longer time, before souring. Heating cures some defects that low cooling only imperfectly provides against. Heating purifies the milk, and makes it of more value because of its purity, besides affecting the process.

Cooling milk is necessary, whether heating is adopted or not; and slow cooling, by what may be called artificial means, or by the application of water, to get the best results, is desirable. But fast or low cooling, while not necessary, is of questionable value. The special advantage cooling has over heating is that if cooling, which is necessary in any case, can be employed to make previous or artificial heating unnecessary, the labour of artificial heating is avoided.

Water as a Cooling Agency.

What is wanted in a cooling agency are: *first*, a good conductor of heat; *second*, a moderately low temperature, and one that is as unvarying as possible.

(1) The better a conductor of heat the cooling agency is, the more rapid will be the cooling. The more rapid the cooling, the larger the body of milk that may be cooled at a time. By setting milk in large bodies convenience is secured, also a saving in milk-room, in cost of utensils, and in labour.

(2) A cooling agency that will have a low and uniform temperature will provide against conditions that prevail in air-cooling, especially in summer. In summer the temperature of the milk-room may be too high to get a right falling temperature. At any time of the year air in the milk-room is changeable, and the variations in the temperature are unfavourable to cream rising.

(1) Water or ice best meet these conditions; water and ice are excellent conductors of heat. The blacksmith uses water to cool his irons quickly. A hot iron or stone dropped into a pail of water quickly gives out its heat, which is taken in by the water, until both are of an even temperature. The hands, dipped into cold or hot water, become cooled or heated more quickly than when held in a like temperature of air. These are examples familiar to all.

(2) Water does not change its temperature in the degree that air does. However high the temperature of the air, water may be found in wells, springs, etc., that maintains a comparatively uniform and low temperature. Limited quantities of water, but sufficient for dairy purposes, may be found available for most of dairies at a temperature from 60° to 45°, which will serve to cool milk even in summer. Ice, of course, maintains its even temperature so long as it remains ice.

Other Purposes Served by Water when used as a Cooling Agency.

Floating in the atmosphere are found germs of decay which milk readily absorbs. It is even true that milk, when newly set, gives off odours that are taken in by previous settings of milk, which are usually of a temperature lower than the new milk. Water may be used as a protection to the milk against all such outside odours. If water of a temperature lower than the milk stands between the milk and the outer air, it will serve a double purpose: it will prevent the odours from the air reaching the milk, and it will allow the odours to escape from the milk. In cooling milk lower than the atmosphere, such a provision for protection is necessary. While the milk is warmer than the air it gives off odours, which would not escape if the vessel were covered from the air, and no

water between the milk and air. On the other hand, it will not do to leave milk uncovered that is cooled by air, for when the milk would become colder than the air it would take in odours instead of giving them off. Water is the suitable medium, as it being itself the cooling agency, is never colder than the milk. The advantage in the use of ice is that the water may be kept at a uniform temperature so long as the ice is melting, thus making a less quantity of water necessary. The objection to the use of ice is where it causes *too low* cooling.

Care of Cream.

The question now arises, How often shall churning be done, or how much cream should be churned at a time? If the dairy be large enough, the practice may be followed of churning each milking separately. In this case the cream would be churned either sweet or at the first approach of souring, and in such practice what the product would lack in quantity (if any) would be more than made up in quality. There are few private dairies, however, large enough to adopt to advantage the practice of more frequent churning than twice or three times a week. It will be the exception to churn daily, and it will be the rule to gather several skimmings of cream for each churning. In this case, if the several different lots of cream be not well mixed and equally advanced, or ripened, there will be a loss of butter. Some of the cream will churn first, leaving the rest to pass off in the butter-milk. This loss may be a larger percentage than those not familiar with the matter would believe. The writer has known it to be 30 per cent. There will be a loss in quantity, and possibly a loss in quality. The cream that is riper breaks first, and gets over-churned before the butter from the latter cream comes. There is, fortunately, a possible security against this double loss. The souring of cream is checked by the addition of fresh cream, and the souring of the fresh cream hastened. If the two stand together thoroughly mixed, the souring of one is checked and the souring of the other accelerated, so that the two lots come to be equally advanced towards sourness, or equally ripened.

Colouring.

The best way to colour butter is to select good cows, and to give them the food that will make a fine, *natural* butter-colour. If artificial butter-colour be used let it be under the following conditions. *First*, that it be a commercial necessity, or add to the value of the butter, and make it sell more readily. Taking the demand as it is, butter will sell better in the general market if well coloured, whether the colour be given by natural or artificial means. If a direct connection be maintained between the consumer and producer, the reputation of the producer may satisfy the consumer without the help of artificial colour. *Second*, that the colouring used be *tasteless*. The natural flavour of butter, even as its natural colour, is the best. Nothing should be taken from it, and certainly nothing added, except salt. *Third*, that it be harmless, or not injurious to the keeping quality of the butter. An improved colour at the expense of quality would be poor economy.

Churning.

Cream is in the form of minute globules. These globules are particles of fat enclosed in membraneous sacs. The problem of churning is to break these globules, to separate the fat from everything foreign, and to do this without injury to the butter.

To save the grain, the agitation of the cream must be by pressure without the friction of grinding. To save the grain and to separate from the butter the buttermilk, or foreign matter, the thickness of the cream and temperature have to be attended to.

Consistency of Cream.

The thinner the buttermilk the better it will run off, and serve as a vehicle for carry-

ing off all solid matters foreign to the butter. If the buttermilk be made thin by thinning the cream before churning the grain will be better protected during churning. By having the cream thin rather than thick when agitated, the grain is better protected by its liquid envelope. This makes it advisable to have more or less milk added to the cream before churning.

Temperature of Cream.

Temperature has a large influence both on time of churning and quality of butter. The churning may usually be done with good results at 60°, or it may be done a little below or above that degree, but the variation that may be allowed is limited, and depends upon the condition of the cream. The lower the temperature the longer the time in churning; the higher the temperature, above the right degree, the poorer will be the quality. If the churning be done very much lower than 60° it will take too long to bring the butter with no good result in quantity, if much above 60° the butter will be softer and therefore less firm in texture, and not so well coloured.

As the temperature does not affect the cream materially before it begins to break and free the butter from its coating, advantage may be taken of a moderately high temperature in the beginning, *provided the cream be cooled before it begins to break.* The disadvantage in this course is the greater care and skill needed to lessen the risk of allowing the churning to proceed too far before cooling down the cream.

The more favourable the condition of the cream at the time of churning, the less agitation it will require, or the lower may be its temperature to churn in a given time.

After the butter has come and begun to gather, has advanced to the proper stage for washing it, a lower temperature than 60° is required. If much above 55° it has too sticky a character and is not so easily freed from foreign particles. If at 55° the particles of butter harden and are washed to better advantage.

Stopping the Churning.

The only time that all the buttermilk and what it contains can be separated from the butter, and removed without requiring to knead, or over-work the butter, is while the butter is yet in a granulated form. If the churning be so far advanced that the butter will be gathered into a large lump, it will have all through the lump more or less buttermilk, in which buttermilk there will of course be membraneous or caseous or other solid matter. Not only will the grain of the butter be injured by the kneading required to remove this buttermilk, but the kneading will remove little else than the liquid of the buttermilk, *leaving much of its solid matter incorporated with the butter.* The kneading of the butter tends only to press and solidify all the solid matter of the mass, squeezing out only liquid. Moreover, when the buttermilk is gathered into a lump of butter, any taint or impurity in the buttermilk by closer, longer, even permanent, contact with the butter materially injures the quality of the butter. If, on the other hand, the buttermilk and all it contains be drawn away before the butter has advanced beyond the granulated form a more perfect result is secured. By washing the butter at a low temperature with water and brine, the buttermilk and all it contains may be removed from it, and before any taint or impurity has been given to the butter, and the grain be saved from the kneading that otherwise would be necessary. In this process butter will be taken out comparatively little affected by defects, or taints, in cream. Cream may be advanced more or less towards a bitter taste, or decay, and the butter, because being enclosed in and protected by its pellicle, not yet affected. It is because of this protection that sweet butter may be made from sour cream. Sourness is an advancement towards decay. It is equally true that the cream may be more or less bitter and the butter hidden away in it be yet sweet. When churned the sourness or bitter is in the buttermilk and the butter is yet pure. The buttermilk adds its sour or bitter taste to the butter according to the quantity and the time of its presence with the butter. The obvious remedy is the quickest and most complete separation possible.

If these facts were italicized, and their meaning emphasized in the practice of all the

butter-makers of the country, the good result could hardly be estimated. The stopping of the churns of the country at the right time would add enough value to the butter product to stop the national debt, or make a sinking fund to pay it.

Preserving the Grain.

Butter is in the cream in the form, principally, of particles of fat, enclosed in a membraneous covering, the whole called a globule. The particle of fat has an individual structure. This structure may, by the force of heat or friction, be destroyed. To save it in its natural form is to "preserve the grain." Butter with a perfect, or natural grain, has many essential qualities that give it value. It has a finer colour, and a clear, waxy appearance, unctuous taste, and a good keeping quality. The melting point of butter, upon which mainly depends its keeping quality when subjected to a high temperature, depends, in turn, mainly upon its structure, or grain. If butter, on its way to the consumers is to be exposed to the influence of heat, it must have its structure preserved, in other words, it must have a good "grain."

In the Milk.

To preserve the grain, the operator must begin with the milk. The milk must be subjected to the least and fewest possible changes of temperature, and the necessary changes of temperature must be of a character to least affect or *try* the structure of the grain. This requires that there be no unnecessary heating or cooling, and that what heating or cooling is necessary be such as to produce the desired results *with the best effect on the grain.*

In the Cream.

The care of the cream will follow. The cream should be kept at an even temperature, and not so long a time as to advance the souring or decaying process into the butter that lies in the cream. Any changes in temperature of cream, or keeping of cream to give it age, are necessary, if at all, for some other purpose than to preserve the grain.

In Churning.

Churning the cream is trying to the grain. The cream, in being churned, must be agitated so that it will get pressure upon its whole body from the outside, rather than friction, caused by the moving of dashers through and through it.

In Washing.

The preservation of the grain depends again upon the washing process. If the butter-milk be not mostly or all removed from the butter while the butter is yet in a granulated form, the grain must suffer injury from the kneading, or over-working, required to press out the butter-milk. The washing, therefore, of the butter, in its granulated form, in water or brine, has an important part to play in preserving the grain.

In Pressing.

The pressing of the butter is a critical time for the grain. Pressure, if direct and gradual, for the purpose of *squeezing out water*, the temperature of the butter being right (or 58°), will not materially injure the grain. The water, so long as it is in the butter, in some measure protects the grain; but as the butter becomes dry, the strokes begin to tell against it. Consequently, every unnecessary stroke will be too much. This shows the value of a cloth or sponge used in connection with and simultaneously with the pressing of the butter. When the lever presses out the water so that it lies on the surface, it may not always run off immediately. Soaking it up with a cloth or sponge is the way to remove it the most speedily, effectually, and with the least harm to the grain.

In Salting.

Lastly, the salting must be done with care and skill, if the grain, so well preserved up till now, be not injured in the end. Salting requires more or less pressure. From what has been said, it will be seen that if the salt be pressed in when the butter is dry it will be harder on the grain than it would be when the butter would be moist. This effect is aggravated by the salt, the grains of which may tend to cut the butter-grains. To avoid this effect, the salt may be added and incorporated *during the process of pressing* the butter, so that when the butter is pressed and the water sufficiently worked out, the butter will also have been salted, and the salt mixed in evenly. An advantage is gained by pressing and salting at two different times, or doing the work with an interval between. The action of the salt, while standing, has the effect of removing the water from the butter.

Separating the Butter from the Butter-Milk.

The keeping quality of butter depends, more than upon any other one thing, upon the entire removal from the butter of the butter-milk and what the butter-milk contains. Butter is mainly a fat, which fat, purified of everything foreign, will keep, without salt, if protected from the air. Salt would not help it to keep. Indeed, the two things, butter-fat and salt, have no chemical affinity for each other. On the other hand, butter-milk contains a considerable proportion of solid matter of a membraneous or caseous matter, upon which salt has some preservative effect. Butter, as pure as it can be made, by the best known process, will contain more or less of this membraneous and other foreign matter. It will require, at the best, as much salt as would be desirable for the sake of eating quality, to act as a preservative of what foreign matter is inevitable. If an undue quantity of the foreign matter be left in the butter, more salt would be required than would be good for the taste, or eating quality, of the butter. Moreover, while butter, even without salt, is slow to take injury from the air, or become rancid, the foreign matter in butter is quick to spoil or become putrid, and salt in any quantity will only keep back the spoiling for a time. From this it will be seen that if butter is made to contain an undue proportion of foreign matter, it will require, in order to preserve it, so much salt that the taste will be injured, and even then its time of keeping will be limited, because of the presence of the foreign matter. Its life will be shorter, indeed, than that of other and purer butter, *less salted*, or *not salted at all.*

When it may be Separated.

There is a stage in the churning process at which it is comparatively easy to remove the butter-milk and all it contains. It is when the butter is yet in a granulated form, at which stage the churning may be stopped, and the butter washed with cold water and brine.

Advantage is taken, at this stage, of the different specific gravity of the several parts of the whole mixture. The butter is lighter than the water; the caseine, etc., is mostly heavier than the water. After agitation, the butter rises to the top of the water, and the other solid matter remains mixed with the water, with a tendency to fall to the bottom. By drawing off the butter-milk, or water, from the bottom, the solid matter foreign to butter is more or less carried away with it. Two or three repetitions of the process complete the separation, sufficiently at least for practical purposes. Advantage may be taken, also, of the difference between the size of the granulated butter and of the solid matter in the butter-milk. The granulated butter being of the size of peas, or grains of wheat, or even pin-heads, and smaller, will not pass through holes, or, in other words, a strainer, that will allow the other solid matter, which is too small to be visible to the naked eye, to pass through it.

Lastly, advantage may be taken of the natural action of salt. Salt has a *drawing* quality, and by using brine in the washing process, even if only once and at the last time of washing, the butter is still more perfectly freed from foreign matter.

Advantages of the Scientific Process of Separation.

Correcting Defects in the Cream.

There are other ways in which the manner of separating the butter-milk materially affects the quality of the butter. Butter washed in its granulated form will be comparatively free from some of the defects that exist in cream, such as dirt, age, atmospheric taint, etc.

Keeping Butter Before Pressing and Salting.

Butter may be pressed, salted and packed immediately after it is churned. If the churning has been done in the old way, by gathering the butter into a large lump in the churn the pressing and salting must be begun at once. But pressing, salting and packing butter every time one churns has a tendency, when there is little cream, of making the operator put off churning till the cream is too old, and it involves more labour than would be required if the working of the butter after churning could be done in larger quantities and less frequently. If the process be adopted of stopping the churning while the butter is in a granulated form, the churning, being a comparatively short process, may be done even more frequently, and the pressing, salting and packing may be done at longer intervals and under better conditions.

Where this process is adopted the butter, of course in its granulated form, is put into a vessel of brine large enough to hold the quantity required. The vessel is kept closely covered in a way to keep butter wholly under brine, and always so covered except when opened to add or remove butter.

When the butter is removed from the butter-holder, and the brine is washed off in cold water, the butter is in as fresh and good condition as when put in. It is then ready for pressing and salting, either for immediate table use or for packing.

Pressing and Packing Quantities at a Time.

Butter washed in a granulated form may be kept in brine, without having been worked, so that the accumulations of different churnings may be pressed and packed at one time. This will allow of churning oftener, if necessary, and the putting up of full packages even in the smallest dairies. This practice of pressing several churnings at one time will result in a saving of time and labour, in uniformity of quality, and in other excellencies in quality that will come of pressing, salting and packing larger quantities, at the most favourable time and under the most favourable conditions. One may choose a favourable time and right conditions under this practice as it could not be done in the old practice.

Less Pressing Required.

Butter washed in a granulated form will require less pressing and so have a better preserved grain.

Saving of Time and Labour.

The advantages in saving of time and labour, and the gain in quality of product, as above referred to, as so great, and in such striking contrast to the disadvantages and loss by the old way of churning, that it would seem the new system has but to be made known to be adopted at once and by all dairymen.

Pressing and Salting.

Pressing is the word to use to express the process that takes the place of the old method called "working," or kneading. *Working* is the proper term to express the whole process of manipulating the butter after it leaves the churn until it is ready for packing. *Kneading* expresses the old process known as "working," and it expresses what in the light of advanced knowledge has been called "over-working." Kneading is the word

used in bread-making. In bread-making kneading is a very necessary work ; in butter-making, kneading is to be carefully avoided. Salting is a part of the process of pressing.

Object of Pressing Butter.

The object of pressing butter is to free the butter from water, or butter-milk, should any remain, to give it a more solid consistency for table use, or for the tub, and mix the salt in evenly.

Butter is sometimes re-pressed ("re-worked") for the purpose of thoroughly mixing different lots, and giving the whole a uniform character and colour.

The conditions of the scientific process of pressing butter are as follows :—

Pressure not Friction.

First.—There should be applied the force of *pressure*, not grinding. The force should be applied as carefully and direct as possible, and no more force or pressure should be applied than is absolutely necessary. Prof. Arnold insists that "all rubbing, sliding and grinding motion must be most carefully avoided, as it breaks the grain, and makes the butter greasy." Butter should be worked, or manipulated, as little as possible. In getting out the water and mixing in the salt, which may be done at one and the same time, the butter may be pressed to its proper solidity or compactness. The butter-maker must take advantage of every means of saving any unnecessary strokes of a lever upon the butter. A cloth or a sponge may be used to press upon the butter lightly and absorb the liquid ; especially at the end of the process must there be no unnecessary pressure. While there is water in the butter, the butter bears the pressure comparatively well, without affecting the grain. When the butter becomes freed from water, and solid, all pressure tends to its injury.

No Hand Contact.

Second.—The hands must not be allowed to come into contact with the butter. Not only does the touch of the hand by its heat injure the grain, but it is likely to impart a taint. If a person be in a state of health, the hand will be too warm ; if not in a state of health it will be even worse for the butter. In health or otherwise there are emanations from the pores of the skin that should be kept away from so extremely sensative a thing as butter.

The best thing to bring into close contact with butter is some material that is a poor conductor of heat, that can impart no taste, and that can be easily and thoroughly scalded and cleaned. Wood, sponge, cloth, etc., meet these requirements.

Proper Time and Temperature.

Third.—Butter should be pressed at a proper time, and at a right temperature. The *Maryland Farmer* says, that butter when pressed at too high a point "gravitates towards stickiness, and when worked at too low a point the texture is destroyed." The time to press butter is when it is being prepared for the table or tub. The practice of the Hon. Harris Lewis is to complete the whole process at one working. The practice of some others is to give the butter two pressings. After the salt has been put in and the pressing is partially done, the butter is allowed to stand over from six to twelve hours, for a second working. This has the double advantage of the action of the salt drawing out some of the water, and with less pressure making the butter more solid and compact. The salting should be done during the process of pressing.

Pressing in Quantities.

Fourth.—Butter should be pressed, if possible, in quantities of a package at a time. The main advantage hitherto possessed by the creamery over the dairy was the churning

at one time, in the one case, a quantity sufficient for one or more packages, and in the other case, of only a few pounds at a time—it taking several churnings in dairy practice to fill a single package. There is a considerable market difference between a package filled at different times in layers of butter of various colours and grades, and a package filled at one time with butter of a single quality in every respect. A complete, uniform and marketable package at every packing is possible by adopting the plan already shown, of washing the butter in a granulated form, and keeping the butter in small particles, in a covered receptacle of brine, unpressed, until a sufficient quantity is gathered to pack one or more full tubs at a time.

Minimum of Labour.

Fifth.—The work should be done with the minimum of labour, a condition, of course, of every process in butter-making. The use of a mechanical helps, and the adoption of the scientific method, as explained, will reduce the labour to the lowest point.

Object of Salting.

There are two main objects in salting butter.

First.—To please the taste of the consumer.

Second.—To make the butter keep.

Which objects should take precedence, will depend upon the process up to this point. Eating quality and keeping quality are almost of equal importance, and they are both so important that neither should be sacrificed to the other—that is, both objects must be kept in view. Now, neither eating quality nor keeping quality depend wholly upon salting. Both qualities are more or less affected by the whole manufacturing process, and salting is but a single factor. There are two courses open to the butter-maker. One is *to adopt the best scientific process*, all through, *salting to the taste.* The other is to follow a system or way of working that is faulty, and then salt with a view to cure defects, even though it be to sacrifice the eating to the keeping quality. Good reasons may be given to show that the first method is the only one that may be tolerated.

Sacrificing Taste to Keeping Quality.

Over-salting, even though some other good were secured by the doing of it, will offset much of the good that has been the result of previous care and skill. Over-salted butter is always butter of inferior quality. The second reason is that the keeping quality of butter depends *very little upon salt*, but a *great deal upon the whole process.* The principal constituent of butter is fat that has no chemical affinity for salt. Fat and sugar have an affinity for each other such as neither of them have for salt. Fat like sugar will keep if dry and pure. Exposed to the atmosphere both would be subject to chemical change, but that change would be slow. But mix with either of the two substances anything subject to quick decay when exposed to the effects of atmosphere, especially if moisture be added, the keeping qualities of both would be materially lessened. For instance, salt would not give butter-milk good and long keeping qualities, and fat or sugar adulterated with butter-milk would spoil quickly in spite of salt. If butter were dry and pure the problem would be easy; but, as a matter of fact, there is in unpurified butter, at its best, foreign matter that is more subject than fat to quick decay; it is the caseine and other foreign matter, and water, which butter contains. This foreign matter, unlike butter, has poor keeping qualities; it spoils quickly; salt has some affinity for it, and a preservative effect, but to be made to keep long and well, it must, as it were, be *pickled* in salt. From this it will be seen that if salt is depended upon for keeping butter, it will be *because of its effect upon the foreign matter*, rather than upon the butter itself. In this case the salt must be incorporated so thoroughly in every part of the butter that none of the foreign matter can escape contact with the salt. This is a thing difficult to do, and requiring considerable skill to accomplish, if indeed it can be accomplished, with any certainty at all. The larger the proportion of foreign matter, the more salt and the more skill

required. Therefore, if the general process, up to salting, has been such as to leave a large proportion of foreigh matter in the butter, so much salt will be required to make the butter keep, that it is sure to have the defect of being over-salted. Other defects would be involved, such as injury to the grain from over-working, also injury to flavour of the butter which, because of the lack of chemical affinity, the salt in excess is sure to add. This course may be expressed as an attempt to sacrifice taste to keeping quality—with the partial success of sacrificing one quality and not securing the other.

Salting to Suit the Taste of Consumer.

The other course is open and may be followed with a far better result. It is to make the taste the rule for salting. The first reason for adopting the method of salting to suit the taste is the general need in all cases of making a first quality of butter. The two facts to bear in mind are that while the foreign matter in butter is subject to quick decay and can be preserved if any time at all only with difficulty, butter itself is slow to change, and with less skill may be made to keep longer than the other. The rule that follows is easy and plain. Make it an object at every stage in the working, or manipulation, of the butter, *to remove all the foreign matter possible*, and provide against over-salting *by making salting less necessary.*

A Minor Object in Salting.

Another but lesser object in salting is to take advantage of the active qualities of salt, to help the process of manipulating the butter. It is difficult in washing butter, even when it is in fine grains, to completely take from the butter the butter-milk and what it contains. Salt has the effect of drawing out the butter-milk. This suggests several uses of salt as an aid to the process. Brine may be used in the washing of the butter. Again, the salting may be done while considerable water is in the butter. By so doing a larger quantity of salt is used, the extra quantity running off with the water after having had its drawing out effect. Still another practice is to partially press and salt the butter, allow it to stand over for six or twelve hours and then complete the work.

Packing.

The packing of the butter is hardly less important than the quality in making it. The best of butter may be ruined by being exposed, on its way from the producer to the consumer, to unfavourable conditions. Butter will not stand changes of temperature in frequency or range, so well even as milk. Again, butter is hardly less sensitive than milk to odours. Butter at its best, and well protected, will keep as long as the needs of commerce demand, and will stand exportation to countries whose climate is very trying, but it must be at its best in make and packing. The main essentials in good packing are a good tub properly prepared, compactness and uniformity, and outside appearance.

The Tub.

Butter should be packed in good new tubs of convenient form for the market for which the butter is intended. It should be made of wood that has little gummy matter, or anything else objectionable to the butter. It should be light in weight and neat in appearance. The form of butter should be adapted to turn out the butter for weighing or examining it, and if possible it should be air-tight. It must be as cheap as may be consistent with quality.

Preparation of the Tub.

The ordinary tub contains a gummy substance that by the action of the salt is drawn out and taken up by the butter. The wood, too, is more or less porous, and favours loss

of brine, and is not perfectly air-tight. The tub, if properly prepared before packing, would be free from these defects. Hot brine will draw out the gummy substance, and fill the pores, making the tub air-tight.

Compactness and Uniformity.

Solidity will be secured by giving the butter a second pressing. The butter is given a first light pressing, is left over for six to twelve, or fifteen hours, and is given a second pressing to complete the process. To secure uniformity the best plan is always to work and pack a full tub at one time. This can be done in small dairies, where churning is done frequently enough, only by the adoption of the scientific process. The butter washed in its granulated form, kept in a barrel of brine until the necessary quantity accumulates, may be pressed and salted and packed at one working, in that way making a full package at a time.

An Improved Marketing System.

Evils of Present System.

The profits in butter-making depend sometimes, at least, hardly less upon the proper marketing of the butter than upon the manufacture of it. Observation will show it frequently happens that good butter often sells for less than it is worth, while poor butter is disposed of at a price above its value. There are several causes for this state of things. There is, first, a difficulty in knowing, by its appearance, the keeping quality, and consequent value of new butter. Then there are defects in the marketing system which make it difficult for the butter-maker to get actual value.

The Remedy.

The remedy for this lies in a better marketing system; or in the establishing of a marketing system, for at present such a thing does not seem to exist. What are the advantages that may be availed of in the market? *First*—*quality* of product; *second*—*quantity* of product; *third*—a *connection* maintained between the producer and the consumer.

1. *Quality of Product.*

Quality is the whole merit of butter. Butter is mainly a luxury; it is a necessary only as its use as a luxury has made it difficult to do without it. It is its character as a luxury that gives it high value. Its character as a luxury is maintained only when its quality is superior. Quality thus becomes almost everything in butter to give it value. There is hardly another manufactured article where quality has so much effect on the market as it has in butter. Not only its price, but the quantity consumed (this, in turn, affecting both demand and price), depend upon quality. If the butter be good, the buyer, if he can afford it, will have it at any price. If it is bad, there is hardly a buyer for it, few butter-eaters being willing to eat it, though paid to do so.

(Uniformity.)

One factor in quality in butter, so far as it affects its marketing, is *uniformity*. Each package must be of uniform quality, and there must be a uniformity of quality in the supply from the dairy, or district, from one time to another. Instances are not rare in which a package of thoroughly good butter has been lost because it was made up of different layers, differing, it may be, only in one respect—such, for instance, as colour. Though the intrinsic value of a package be not in the least improved by its being uniform in appearance, its value in the market, not to say its chance of being well sold, will depend largely upon that uniform appearance. The object of having uniformity of quality in

the different time to time supplies is to keep up the demand. The buyer of a good lot of butter will naturally look to the same source for a similar lot. If a second lot should be inferior, the buyer will be all the more disappointed, because of his raised expectations. If he obtains a second lot equal to the first, he is more than pleased, and future supplies from the same source begin to be a necessity to him. The longer this continues the better for both buyer and seller, especially the seller. It is in this way that a reputation is established, which makes selling easy and brings high prices. This is one of the factors of the high prices obtained for gilt-edged butter.

(Appearance.)

Another factor of market quality of butter is appearance, both of the butter itself and the package, or its covering and surroundings. The butter-eater enjoys eating butter only when he believes it to have been made by cleanly persons in a cleanly way. Persons are met who never touch butter, because having in some way become disgusted with it at some past time. People will frequently judge by the appearance of the butter, the manner in which it is put up, whether or not it is clean and good. As it strikes the eye, so does the buyer judge the quality, or its fitness for the palate. Certainly intrinsic quality must support the appearance; but it is equally true that if appearance is against butter other quality will not wholly save it.

2. *Quantity of Product.*

Except in a "near-by" market, where the producer directly supplies the consumer, quantity is an important factor in marketing. The larger the quantity, other things being equal, the better the chance for selling easily and well. Where the producer does not sell directly to the consumer, there are necessary, of course, one or more agents, or middle-men, who "handle" the butter. Manifestly there is great advantage in handling large lots, and the farther off the consumer, the greater the advantage.

3. *Connection Between Consumer and Producer.*

There is nothing in marketing butter of more importance than keeping up such connection. If all the butter were equally good, this would be of little or no importance; but where quality is everything, as it is in butter, and when there is so wide a difference in quality as there is to be found in butter the connection is of first importance. The consumer, or the buyer who supplies him, should know the maker of the butter. If the maker of the butter is not known the result is different: the maker of the best quality obtains the average reputation, which is lower than he deserves; while the maker of a poor article profits in that the average reputation is higher than he deserves. If the proportion of bad butter to good butter is large, the injustice is still greater. One good tub of butter in ten will not do anything to raise the general reputation in any appreciable degree, to bring any measure of justice to the maker of the one good tub. When the disparity is in so large proportion even the maker of the poor butter does not seem to profit by his neighbour's loss.

The only remedy for this is to have the connection maintained between maker and buyer, or consumer. When the consumer buys butter that he does not like he will be careful to buy no more. But when the consumer finds upon his table a choice article he will be likely to rest satisfied only when he has gone to the source of it and secured a continued supply. This will really benefit all parties concerned. It is annoying to the consumer to go to his grocer for "more butter like the last," and be given another and inferior quality. To give him the best and as much of it as he likes is to make him a better satisfied customer and a larger consumer. The maker of good butter will get more nearly what his butter is worth, and profit by and enjoy a well-earned reputation. The maker of poor butter will get at least his due, and the poor satisfaction that he will find in a slim reputation and slimmer profits, will perhaps induce him to adopt the best remedy, better methods and improved quality.

It seems strange that this matter of reputation is not accounted of more importance. The manufacturer in other lines is wiser in his generation than is the butter-maker. The piano manufacturer is careful to give his piano a name and to try to build up a reputation for himself. If he makes a poor article, he gives it the name of some other maker, real or fictitious, so as to lose nothing by putting something inferior on the market. As with the piano-maker, so with the cloth, leather, implement, and other manufacturer. If it be policy with the maker of goods that are necessaries and will be bought, to a large extent, even if of poor quality, how much more is it policy for the maker of butter which, being a mere luxury, will be bought, as butter, almost only in proportion as it is of first-rate quality.

It is not the maker of bad butter who has most need of a better marketing system, such improvement is demanded more by the maker of a superior quality of butter. The maker of gilt-edge butter would get no better price than his neighbour if he were not wise enough to get the benefits of a good marketing system. He has direct and immediate connection with the consumer of what he makes, and that combined with the basis of a good system quality—brings him a good reputation and large profits.

How will this be attained? The adoption of the best method will secure quality also uniformity. If the quantity be very small let an effort be made to have as near and direct a market as possible. If there be a number of butter-makers in a neighbourhood whose butter is of prime quality let them club together and give their combined product a brand, and, by keeping it from the inferior butter sold about them, secure the advantages both of quality and a trade connection.

MILK PRODUCTION.

The butter-making in the dairy does not begin with milking. The production of milk is practically a part of butter-making in the private dairy. The butter-maker on the farm, unlike the factory worker, produces his own raw material. The limits allowed this manual will not admit of the full treatment of the subject of milk-producing, but space must be taken at least, to draw attention to that important part of the butter maker's work, and to give a few hints that may be valuable.

Milk the Raw Material.

Milk is the raw material which the butter-maker uses to produce butter. Both quantity and quality of product depend largely upon this raw material. The butter-maker who adopts a scientific method, will not only work up his raw material in the best manner possible, but he will want that material to be first good and then cheap.

Steel which is raw material in the manufacture of many things, is itself a manufactured article. Just so milk, the raw material which the dairyman uses, is itself, as it were, a manufactured article. In the production or manufacture of this material, feed is its raw material, the cow is the machine, the dairyman is the workman.

The Cow, or Machine.

Natural Function of the Cow.

It must be remembered by the dairyman the milk-giving function of the cow, in its natural working, is the producing of milk for the offspring. The quantity of milk, its character and the season of its flow, are adapted to the needs of the calf. The quantity is comparatively small, the milk itself is poor in that which makes it valuable as a raw material, especially cream, and the flow is of short duration. The production of a larger quantity, of better quality, the keeping up of the flow, are the result of an artificial development of the natural function.

Development Artificial.

Cows will be profitable then for dairy purposes, according to the degeee of the artificial development of the milk-producing function. This development is purely artificial, and man is the agency by which it has come. Upon man, then, depends the obtaining of any advantage or profit from the functions of the developed cow.

Conditions of Profit from Development.

There are several things to be considered in the effort to make a profit from the development in the cow of her natural function of producing milk. Not only is the development artificial and must be caused by artificial means, but it must be sustained by the same means. The tendency of the cow is constantly towards her original state, and that tendency is strong. If the means that have been used to bring the cow up to her high state of developed capability of production are not in some measure kept up, the result will be a falling back to the original state. This has to be kept in mind by the dairyman. If his cows are imperfectly developed, the dairyman must know that he is not getting full advantage from them, and that he will get such advantage from them in no other

way than by artificial means. The dairyman must know, too, that whatever may be the degree of development of his cows, if he would have them at least to hold their own, he must in some measure use the same means that brought the cows up to their present state of development. If this be not done the cows will fall back towards their original state of undevelopment.

Means of Development.

The cow, by nature, gives milk for its calf. She stops giving milk when the calf stops sucking. When the calf is taken from the cow she allows man to draw her milk. The tendency of nature is to adapt herself to existing conditions. If the calf was to suck longer the cow would continue longer to give milk. Man continues drawing the milk, and the cow acquires a habit of giving milk a longer time. Thus man by milking develops the milking habit of the cow, or keeps it up. Good milking, or frequent, regular and complete milking, favours the milking habit.

The tendency in nature is for the parent to transmit to the offspring its own peculiar qualities, and especially its characteristics that are strongest and in most active exercise. Consequently a good milking habit being induced and sustained leads under favourable conditions to transmit itself and even to an increased degree.

Here then we have a suggestion of the means of development. The encouragement of the natural habit, and the taking advantage of the tendency of like to produce or transmit like. It is by these means that we have in the developed cow so great a contrast to the cow of nature—the encouragement and development of the milking habit, and the careful breeding which transmits and even increases the habit.

Breeding.

It is not the purpose of the writer to enter fully into this subject. By selecting breeding, any characteristics of the cow may be developed. The breeder will then aim to develop such qualities as will make the cow of most value for the purpose intended. If for making cheese, he will make the quantity of the flow of milk his first object. If for butter-making, the development will be first for quantity and quality of cream.

Feed as Raw Material.

A certain amount of fuel is required to heat the water in a steam boiler to the point of steaming, and to sustain that heat. Up to this point no force is produced. If heat is supplied over and above the amount necessary to reach the steaming point and sustain it, the result is the expansion of steam and the obtaining of power. Before this steaming point is reached, there is practically no return from the use of fuel to produce heat; as soon as it is reached but little is required to maintain the heat, and the rest that is applied all goes to supply force.

The same law holds good with the cow. A certain amount of food is required to supply the animal economy, to build up *even the machine itself* and to sustain it in its action. Up to this point there is no return from feeding the machine, unless it be by drawing upon what has been stored up before in the animal economy. If there be any profit at all, it comes from the supply of fuel or food *over and above the amount required to furnish the animal economy.* The profit, therefore, in keeping cows and feeding, comes from the supply of all the food that they can best utilize. If a short supply be given there is so much taken from the margin or profit.

Feed also has its place it the development of milking qualities of the animal fed and the characteristics of the offspring. The law is always good that the animal economy must first be supplied. An under-fed animal can only feebly transmit its qualities, if its own individual requirements be inadequately supplied.

Again, feed is the material from which milk is made; the quantity and quality of milk depend upon feed. Let the food be deficient in amount, or deficient in its composition, the milk will be less in quantity and of poor quality. The food must be abundant and good.

Water enters largely both into the animal economy and into milk. It follows that water, too, must be supplied in abundance and pure.

It is food that supplies the heat required in the physical economy of the animal. All food does not contain in equal amount the elements of warmth. The food must be of a character to supply heat.

The feed question opens up other ground practically included in the butter-maker's work. It is the *supply* of cattle feed. The butter-maker, after he will have become efficient in the scientific method, may profitably give attention to the keeping up of his soil, to pasturing, to hay, root or grain growing, to ensilage, etc., etc. This brings the writer to the limits of the particular object of this treatise.

The Dairyman or Workman.

The best engine and the most abundant supply of good fuel and water, without the agency of intelligence, will not evolve either heat or force. Without the intelligence of the dairyman the cow remains in the undeveloped natural condition, the conversion of feed to milk is limited to a quantity and quality suitable to the needs of the calf, and. the butter-maker has a lack of raw material. It is for the dairyman to understand the importance of the matter of the production of raw material for the manufacture of butter. Not only should he not by ignorance allow the machine to deteriorate from the state of perfection in which he found it; not only should he maintain all that has been gained by intelligence in the past; but he should aim at an even higher degree of perfection.

The dairyman will provide the cows with suitable *shelter*. Any undue exposure to cold is a waste of heat, which is a waste of food from which animal heat is evolved. Unnecessary cold is a loss for two reasons. Not only is extra food required, but the animal has to expend so much more force or energy to digest that extra quantity of food.

The dairy-man will feed *regularly*. Regularity means to the animal health and the best working of the organs of the animal. Should neglect cause impairment of the health of the digestive organs, for instance, there will be required an undue force in the work of digestion, and a waste of food which is eaten but undigested and unassimilated.

It is for the workman or dairyman to make the best use of the machine or cow, to supply it with the best material, and to take such care of the machine and feed it in such a manner as to get the best results at the least cost.

UTENSILS AND SUPPLIES FOR SCIENTIFIC BUTTER-MAKING.

Butter-making is possible with the simplest and most primitive appliances. Butter has been made, and may be made again, by concussion in the skin of an animal. An animal gave the milk; an animal furnished the apparatus. Butter may be made with a bowl and a spoon; butter may be made with a few little old pans and an old-fashioned dash-churn, with nothing else. Yet there are butter-makers who do not think their dairies are properly equipped without a thermometer and all the apparatus that modern ingenuity has invented for the dairy. Whether it is wiser to continue in the use of primitive appliances, or to utilize the best of modern improvements, may be determined by the results of the different practices. This being true, it is enough to say that the most successful butter-makers adopt the best mechanical helps available.

First are the Danes, who are, perhaps, more successful than all others. Says Prof. Sheldon:—"They study the principles of their art, which are propounded to them by scientific teachers, and they follow out the most approved systems, and adopt the most modern utensils."

Prof. Bell, speaking of the "marvellous advance" in cheese-making, attributes much to mechanical aids. He says: "The apparatus supplied now leaves little to be desired, furnishing a striking contrast with the past. I will instance the jacketed vat and the gang-press. The recent improvements, both in apparatus and methods, have the advantage over the dairymaids of former times that the disciplined force carrying the repeating rifle and revolver would have over a tumultuous mob armed with the javelin and bow and arrows of antiquity."

Butter-making is quite as much as cheese-making dependent upon mechanical helps, and the contrast between the practices of the "dairymaids of former times" and the advanced methods is quite as striking in the butter as it is in the cheese dairies.

Miss Morley, the "Champion Butter-maker," of Wisconsin, is an example of the successful dairymaid of modern times. She says: "I do advocate a more thorough investigation of improved apparatus for butter-making, and a more enlightened knowledge of different methods than to many seem necessary."

It is quite unnecessary to take up limited space to support an argument that will be very generally admitted, with even less proof than has been given. It is allowed that there are individuals who can make up in care and skill for lack of appliances, but it must be claimed that even these individuals will find great help and profit in the help of better appliances; and as to the many who lack the superior skill, it is only by the help of suitable appliances that they can hope to attain any good result.

The advantages to be found in the use of a single instrument—the thermometer—have only to be hinted at to be generally appreciated. The change that has come in the wake of the introduction of the sewing-machine is an illustration of the possible advantages to be found in the introduction of improved dairy utensils. The difference between old-time butter-making and scientific butter-making is much like the difference between sewing by hand in the old days and sewing with the wonderful modern machine. The change made in one case shows the change possible in the other. The means of improvement in one case may be the means of improvement in the other case—mechanical aids.

General Characteristics of Dairy Utensils.

There are some points of merit that are common to various dairy utensils. They are: *First*—Adaptability to the object intended. *Second*—Simplicity of construction and working. *Third*—Working easily. *Fourth*—Washing easily. *Fifth*—Cheapness. *Sixth*—Durability.

The Thermometer.

Temperature is one of the most important factors in scientific butter-making, and the instrument by which temperature is determined—the thermometer—may be said to be a key to scientific butter-making. Without regard to the temperature all the other factors and conditions are subject to chance. Without the aid of the thermometer the determination of the temperature is, except in rare cases of individual skill, a mere matter of chance. In past time, when butter-making was purely a rule-of-thumb process, the value of the thermometer was not known. As intelligent methods began to take the place of hap-hazard ways, the use of the thermometer came to be considered by advanced makers as a necessity.

(*Description and Use.*)

The thermometer itself is a glass gauge, at the lower end of which is a bulb filled with mercury, from which bulb is a continuous channel or tube in which the mercury, when affected by heat or cold, may rise or fall There are figures along the tube that mark the degrees of heat or cold. These figures form in the ordinary thermometer what is known as the Fahrenheit Scale; they mark the number of degrees (°) of temperature. To find the number of degrees of temperature, note at what figure the end of the column reaches when it has ceased to move. In most thermometers the degrees are not all marked by the corresponding figures; every ten degrees only are so marked. One may read the intermediate degrees by the short ladder-lines between the figures, each ladder-line usually marking two degrees. To find the temperature of any substance, say of water or cream, hold the bulb in the substance until the mercury has ceased to move (up or down, as the case may be), and note the degree at which the end of the column of mercury rests.

The sort of thermometer best adapted for the dairy is one that is reasonably exact, and one easily washed. It is better not to get too cheap a one, as the cost of the best is an insignificant item. It is better, however, to buy a common weather thermometer, in the nearest retail shop, at the low price even of 25 or 30 cents, than to do without one, if better ones are not available.

Milk-Setting Vessels.

Small open vessels have been largely used in the past, and are in quite common use to-day. They have their points of merit and their disadvantages. The best of this sort of milk-vessel is the modern seamless pan. They are cheap, light and easily cleaned.

Within the past few years have been introduced a new system of milk-setting, or rather, new vessels operated in a new way. They are larger sized vessels, adapted for holding larger quantities of milk, and adapted for cooling the milk by means of water or ice. These milk-setting vessels are called *creamers*. Whatever may be the respective merit of different creamers already in the market, they all, or nearly all, possess at least one advantage over the pans. They are certainly labour-saving implements. There are farmers now using creamers which they claim have not the merits of the old-fashioned pan, except in this one point of saving labour. This seems enough to ensure their use, in some cases, in spite of claimed defects that make them in some respects inferior to the small open pans.

It must not be understood that they all possess but the one claim to the favour of the dairyman. When they are constructed upon scientific principles they will be sure to give satisfaction. Let the dairyman make himself acquainted with the principles of cream-rising, as explained in previous pages, and he will have no difficulty in determining what is wanted in a creamer.

Prof. Arnold in a recent article concerning creameries, in the *Rural Home*, gives a description of the right sort of milk-setting vessel. He says "The best plan for raising cream, and the one which most perfectly accords with the science and philosophy of butter-making, is the following: The milk is set in vats twenty inches deep, but no more than sixteen inches wide, with the length variable, as may be convenient. The upper

half of each vat is surrounded by an envelope of water, ten inches perpendicularly and two or three horizontally. The water is run into the envelope at one end of the vat and passing equally along both sides runs out at the other end. The lower half of each vat is surrounded only with air, and it is all the better if the air is not very cool. This does the cooling at the top of the milk where it should always be done. The law discovered and published by me several years ago, *that cream rises best when the temperature is falling*, is now recognized and adopted by all carefully-observing butter-makers. When cream has reached a low temperature and it ceases to vary, the cream ceases to rise. The temperature of the milk must therefore be kept changing. These vats are perfectly adapted to this law. If the milk becomes reduced to the temperature of the water flowing round it, the vats are arranged to warm the milk a little at the bottom, either by steam or water, sending the warm part up to the top to be again cooled and precipitated, leaving the cream at the surface. The changing temperature can thus be kept up indefinitely without the necessity of extreme refrigeration, which is unfavourable to the production of the best keeping and finest flavour."

It will be seen that the above description accords with the principles of milk-setting laid down in this manual. If the dairyman has brought to his notice a utensil answering the above description he will be safe in giving it a trial. It is all the better if such utensil possesses other merits, such as the general merit of simplicity, cheapness, etc., and special merits, such as keeping the milk pure and providing for the separation of the cream, free from sediment and without unduly mixing cream and milk. As to size, it must be remembered that Prof. Arnold in the above is describing a vessel for the creamery or factory. It is the principle of the construction and the proportions only, to which attention is directed.

Cream-Holding Vessel.

Since there is a loss in churning different lots of cream that have stood in different vessels and ripened unequally, it follows that all the cream of any churning should have been kept for some hours at least well mixed in one vessel. To do this it is necessary to have a cream-holder large enough to hold all the cream of each churning, or in other words, a cream-holder with the full capacity of the churn. This is an important matter and will hardly be ignored by the thrifty butter-maker unless he should be ignorant of the percentage of loss that may come of keeping cream of different ages in separate vessels.

A point of merit in a creamer will be its adaptation to heating or cooling the cream by setting the cream-holder itself in hot or cold water. Tin seems best to meet this requirement, and tin has the merit of being light, easily cleaned, and cheap.

Churns.

Churning is one of the most important of dairy processes. At one time churning was all there was of butter-making; it is a process even now absolutely necessary. It has been the most laborious and unpleasant part of butter-making; it now may be made an agreeable and easy part of the work. Churning has been the means of spoiling millions of pounds of butter; it has now been reduced to a science, and to do it properly and well is to do a large part towards the production of the real "gilt edge."

Churning is a process that almost more than any other in butter depends for being well done upon the implement used. A person who is intelligent and skilful may milk in an open pail, set milk in an open pan, keep cream in a common house jar, press and salt butter with a ladle in a bowl, and be able to pack a fine article. But there are some churns which, though manipulated most skilfully, will completely spoil the product. Harris Lewis says that the churn which brings butter ordinarily in five minutes has ruined the butter in two and a half minutes—*before the process is half done!*

There have been many erroneous ideas about churns, and dairymen have bought churn after churn only to throw them aside, and to come back to the "old dash churn." This has led to a very common claim that the old dash churn could not be improved upon. Yet, the very fact that so many churns have been invented, sold, bought and tried, is a proof that the old stand-by was not perfectly satisfactory. That it has its defects may

easily be seen. It is admittedly hard to operate; churning and turning grindstone have ground out in many young breasts all enthusiasm for the farm. It is not well adapted for washing the butter in the granulated form; and this process is in importance second to no other in butter-making.

Now, there are very few dairymen regarded as authorities who do not claim that the old dash churn is inferior to some other churns. The Hon. Harris Lewis at Belleville, this year (1883), after stating that the "old dasher" was one of the best, went on to speak of churns which he claimed to be superior. If there are better churns, let us make a practical application of the scientific method and see what are points of merit in churns. This will help dairymen to know what is the value of a churn when offered him.

The points of merit in a churn are as follows :—

First.—The agitation should be in such a manner that the cream is churned by *concussion* and not by friction. This is necessary in order to save the grain of the butter, for if the grain be destroyed the butter becomes grease. *Second.*—The cream should be equally agitated, or agitated alike and at the same time. This is important in order to secure quantity, and so that it will not be necessary to over-churn the first that breaks in order to churn what has been retarded. *Third.*—That the churn be adapted for easily washing the butter while it is in fine grains. It is possible that butter from any churn may be washed in fine grains. It may be done in the old dash churn, but it requires considerable skill, and the use of other mechanical help such as sieve, or strainer cloth, to do it. A churn to be satisfactory should be adapted to do this important part of the work in the simplest and easiest manner. *Fourth.*—Ease of working is an essential in a churn. If churning can be made an easy process, then it is especially important that it be done. It was the hard work of churning that brought into favour the quick churn that spoiled so much butter. It is to be believed that to reconcile the dairyman to a return to churning as slowly as is needed, he must not only be assured of better butter, but given an easy-working churn. *Fifth.*—For a churn to be easy-working, a churn, among other things, must be ventilated. If the gas be not allowed freely to escape, the capacity of the churn must be greater to churn a given quantity of cream. Ventilation is essential, too, to quality of product. *Sixth.*—The churn must be adapted for easy cleaning. It is not necessary to enlarge here upon the need for absolute cleanliness in butter-making. It is difficult at best to get operators in the dairy to keep everything scrupulously clean. If the implements are easily cleaned they have a good chance of being cleaned, and sometimes this is their only chance.

Now, how should a churn be constructed to possess these points of merit and the other points common to all dairy utensils, such as durability, cheapness, etc.?

Churns may be divided into two general classes: First are those with stationary bodies, and movable dashers. Second are movable bodies with fixed dashers, or without dashers. It will be found that with one exception the first-class of churns are, in all the five points given, inferior to those of the second-class. Space will not allow the taking up in every point of this matter, but a consideration of the matter, and experience, will establish the fact stated. Further light will also be thrown on this subject in the APPENDIX. The exception noted is that of the dasher churn. It will possess the first merit that of churning by concussion, and will possess in a fair measure the second and fifth qualities, those of agitating the cream evenly and of being easily cleaned. It must, however, be properly constructed to do even this. It will at best be lacking in the third point of washing the butter, and the fourth of being easily worked.

This does not wholly condemn churns of the first class. They are not worthless, but they are certainly faulty and inferior. Some of them are, indeed, worse than worthless, but others of them possess fair merit. The ones which stand best are those which come nearest to the cylindrical form, and have the simplest system of dashers.

Churns of the second-class may be divided into two sub-classes, namely: revolving churns and oscillating churns. Each sort has its advantage and disadvantage. The disadvantages of the revolving churn are the difficulty of making a tight cover, also the difficulty of ventilation. Where they are not properly ventilated they require a greater diameter. The objection made by Prof. Arnold to this class of churn was that they

require two feet diameter to give sufficient fall. The revolving churn, without dashers, fixed or movable, to be at its best should be provided with ventilation, or for escape of gas; its diameter should be small enough to make it easy to work; its cover should be a convenient and tight-fitting one, and it should be provided with a convenient strainer for drawing off the butter-milk, and washing the butter. This done there is little improvement to be ma e in it.

The oscillating churn has one advantage over the revolving churn; its opening being always on the upper side, the cover is easily fitted on. It has the disadvantage of being harder to operate than the revolving churn, and it seems to agitate the cream too much and bring the butter far too quickly. It is best suited for small dairies and in careful hands may doubtless be operated so as not to injure the grain.

The revolving churn is an old churn; it was used and liked over a quarter of a century ago. Mr. Flint, writing in his standard book, published so long ago as 1860, and quoted even yet, says: "It is the concussion, rather than the motion, which serves to bring the butter. This may be produced in the simple square box as well as by the dasher churn; and it is the opinion of a scientific gentleman, with whom I have conversed on the subject, that the perfect square is the best form of the churn ever invented. The cream or milk in this churn has a peculiar compound motion, and the concussion on the corners and right-angled sides is very great, and causes the butter to come as rapidly as it is judicious to have it. No dasher is required, If anyone is inclined to doubt the superiority of this form over all others he can easily try it and satisfy himself. It costs but little."

It may be asked how it is, while there was known a churn which is so near an approach to perfection, so many worthless patent churns could have been sold? There are several reasons. The revolving churn embodied the right principle, but it had several minor defects that have only a comparatively short time been remedied. It had not been generally introduced. Without the modern improvements it has been constantly growing in favour, and is being more and more extensively used. Lastly, it was not popularly known that a churn without dashers was a churn upon a right principle. And in this connection it will be well to note how it came about that so many churns were made upon a wrong principle, sold, and, for a time, used. If we see wherein mistakes have been already made, we are better able to avoid mistakes in the future. The difficulties in churning in the past, that made churning unsatisfactory, were often supposed to lie in the churn, when they were in something else. The old way was faulty in not having regard for the condition of the cream, its temperature, or the capacity of the churn. As a result, the length of time required to bring the butter, and the butter itself, was variable, in quality and quantity. This was all attributed to the churn. The greatest fault of the old churn—that of being too hard to operate—added to its supposed faults, condemned it, and made dairymen look for something better. Its peculiar merit, or the merit of saving the grain and producing good butter, was not fully appreciated; the operator at one time had no notion that grain in butter was of any importance.

Taking into account the real and fancied faults of the churn, and having no idea of what were the actual requisites of such an article, the inventor came forward with a view to help matters. His reasoning was simple: it takes so long to bring butter with the old churn, and the work is so hard something is required that will bring butter at least quicker, and if possible, easier. Here was the rock upon which the hundreds of "patent churns" split, and which ground to grease half the butter of a generation. It was in this way that the country became flooded with egg-beaters and threshing-machines for agitating cream.

Granulated-Butter Holder.

Where dairies are small and churnings are as frequent as they ought to be, the practice may be followed, as explained already, of accumulating several churnings to be pressed and salted at one time. To follow out this practice a vessel is required in which the granulated butter of the different churnings may be kept together. A good, strong barrel, with a close-fitting cover, will serve the purpose. Something must be provided to place on the top of the butter, to press it down, allowing the brine to rise over it, to keep the

butter from being exposed to the air. This is because the butter is so much lighter than the brine. If not weighed down it would be constantly exposed. Something perforated with holes too small to allow the butter to pass through would be the thing required. One thing more would be a convenience, if not absolutely necessary. It is a hole at the bottom and a plug. The plug removed, a strainer could be inserted and the brine drawn off, the butter washed, and the water drawn off in a similar way. Without this convenience the butter may be dipped out with a sieve dipper, and washed or rinsed upon the butter press.

The Butter Press.

The main requirement in a butter-worker, besides the essentials common to most utensils in dairy use, is the adaptability for completely and speedily freeing the butter from water, making the butter solid, and evenly mixing in the salt, and doing this without *injuring the grain*, or requiring an undue expenditure of labour.

The Tub.

The tub should be of *first quality*. This is important; it is not economy to save a few cents on the tub at the expense of its quality. When the tub is inferior, either as to quality of protecting or quality of preserving the butter, or as to appearance, there will be more discount on the butter than will be saved on the tub. One could hardly save on the cost of the tub more than one-half cent per pound of butter, and the defects of the tub might make the butter to sell for say from one to five cents or ten cents less than it would have sold for had it been better packed and better preserved in a better tub. Not only may there be a loss per pound from a defective package and packing, but the butter may be actually unsaleable at any price.

The tub should be *new*. Until tubs are made of a different sort from what are yet in the market they are unsuitable for repeated use. Butter should not be packed in an old tub. Could it be got for nothing, it would be a losing policy to use a tub the second time in which to pack butter. The appearance alone is enough to discount the butter more than enough to cover cost of a new tub. Old tubs cannot be got for nothing, as they are always of some value for other uses; so there is no reason, for the slight supposed saving between the cost of new and old tubs, for using any but a good and new tub. Good machine-made tubs of excellent quality are common and low-priced, making it less an object to use an inferior article.

The tub should be *light in weight* and have a *neat appearance*. The weight affects the appearance, but the advantage of a light tub is mainly that it makes easier handling and a saving in freight. More regard should be had to appearance. Men judge even eating quality through the eye. If it were not for that reason butter-colour, which if good is necessarily tasteless, would find no market. The imagination has more to do with our judgment than we are at all times ready to admit. When one looks upon a fair outside, he is ready to find the inside good enough to warrant the pleasing appearance. When the outside is not pleasing, there is a natural want of expectation of a good inside. From this fact it follows that, while a fair exterior will augment the value of what is within, even though it be of indifferent quality, a poor outside is unpromising and will depreciate the value of what is contained inside, even though it is of excellent quality. It may seem unnecessary to philosophise to this extent on the appearance of butter tubs, but the practical bearing of the subject will warrant all that can be said that will lead the butter-maker to be wise in this matter. While a good appearance is a commercial necessity, it is a fact not to be gainsaid that butter-makers do not all look upon it as a matter of dollars and cents, unless it be in the way of saving a few cents in the cost of the tub. The butter-maker is too likely to look upon the cost of the tub as so much thrown away. This is because he has paid for the tub and is paid only for his butter, having to "throw in" the tub. It is not strange that this way of doing would lead sometimes to a short-sighted policy, and a policy so short-sighted that the importance of a better policy should be emphasized.

The *form* of the tub should be to make it easy to turn out the butter for examination, or for the purpose of getting its net weight. What is called the Welsh tub is becoming the most common in use, and is likely to be the form of the tub of the future.

The tub should be made of the *right kind of wood.* A wood that is strong, light and tasteless, and can be made impervious to air, and brine-proof, is suitable for butter packages. Balsam, white spruce, white ash, white oak and even hemlock, are good wood for tubs. The gummy part of spruce or balsam and the soft part of ash, should be thrown out. Inventive skill may yet give a substitute for wood; something light, strong and cheap, and possessing a polished inner surface that will not soak in brine or fat.

The tub should have an *air-tight cover.* It cannot be said that tubs with air-tight covers, like tubs light and of neat appearance, are common, low-priced and easily procured by the butter maker. But whether they can be procured or not, there is no question as to the great need that a tub be air and brine tight. It is the brine that surrounds the butter in the tub and excludes the air from direct contact that does the most to protect and preserve the butter. Unless the cover is tight, it is a chance if the tub will stand shipment any distance without loss of brine. It is even a question if the tub can be packed so that the butter will be and remain completely covered by the brine. Another reason that the cover should be air-tight, is the necessity for excluding unwholesome odours from the butter. Butter in stores, depots, cars, warehouses, vessels and retail shops, is liable to be subjected to unpleasant or foul odours, some of them being of a most penetrating character, say coal oil, stench of vessels, etc., etc. The simplest and most effectual provision against these is a perfectly air-tight cover on a proper and well prepared tub.

The tub should be *cheap.* Since the tub cannot be used for the same purpose twice, and when the butter is used out it may be sold for a trifle, or thrown away if necessary, the purchaser cannot pay much for it. If the producer gets little or nothing for his tub, he cannot, of course, afford to pay much for it. If the future gives us a tub that may be used over and over again, or has an intrinsic value to the consumers for another purpose, so that he can afford to give the producer something for it, it may be adopted to the profit and advantage of all. Such a package would doubtless be more used for local than foreign trade.

Water—Its Uses.

Water has many uses in dairying. It is used in feeding stock, in washing vessels and utensils, in heating or cooling milk and cream, in washing and pressing butter, and in preparing tubs for packing. It may be used both for cooling and for purifying the dairy, and for ventilating and purifying milk when it is set for cream-rising.

(Pure Water.)

Impure water has no place in dairying. Only pure water should be given to cattle; only pure water should be used for washing butter. All this is imperative. If the cow drinks impure water, it goes into the milk more or less impure. How impure the milk will be is suggested by the fact that milk contains about 87 per cent. of water. Butter washed in impure water is affected in more than one way. Butter being extremely sensitive will suffer by the slightest contact with impurity, and, again, some of the water or its impurities may be left in the butter. Water should be pure when used, as an absorbent, to purify the atmosphere of the dairy, and when used by evaporation, as a cooling agency. When used for scalding vessels, also, it should be pure, and, of course, will be comparatively pure, having been heated to boiling point.

(How to Obtain Pure Water.)

If the butter-maker is wise he will provide for an abundant supply, for all dairy purposes, of the purest water available. He will go to the sources of pure water to obtain the supply. There will be economy in this, although it may involve a considerable outlay of means. He will avoid sources that are sure to be impure, such as stagnant water

wells in close proximity to barns and out-buildings, or even wells that are frequently low and the water in them containing decaying matter, or sediment.

When, after the best has been done, the water is still defective, means may be taken to purify the comparatively small quantity necessary for such dairy purposes as washing butter. And here it may be emphasized that no water that is in any way faulty should be used about butter until every reasonable means have been exhausted to purify it.

(To Purify Water.)

There are several ways of purifying water to make it fit for dairy purposes. Some water requires only to be strained through a fine cloth to remove sediment, etc. If more is required, water may be thoroughly boiled, after having been strained, and allowed to settle and aërate. Always aërate, of course, in a pure atmosphere. The use of a good filter would be both economical and effectual. Salt does not purify water, but it prevents, in some measure, the bad effects of impure water. Sometimes good results may be obtained by merely straining carefully to remove solid matter, and using it strongly brined. Charcoal is an excellent absorbent of bad gases, and it may be used with advantage in the way of purifying water. In one way or another, the water available by the dairyman may be cured of its defects—and defects must be counteracted—or it should have no contact with butter.

Salt.

The uses of salt in dairying are various. Salt is first useful in the process: it has a drawing quality, and its employment helps to free the butter from foreign matter. It is next to be employed in its character of a condiment. Butter without salt, like some other articles of diet when fresh, has for most consumers an insipid taste. The market demands a salted butter, and the second use of salt is to satisfy the taste of the consumer. Salt has a third use, which is incidental. It has an antiseptic quality; and its use in the small proportion necessary to make it agreeable to the taste of the consumer helps to preserve the butter. Salt has another use, that of preparing wooden tubs or packages for butter.

Salt should be pure; yet pure salt in the market is the exception rather than the rule. It is for the dairyman to select as pure a salt as can be found. The most simple test of purity is to watch the effect upon it of damp weather: if it gathers dampness it is impure; if it remains dry it is likely to be satisfactory. Where brine is used it may be boiled, and the impurities skimmed off or allowed to settle to the bottom.

Coarse salt may be used for brine purposes; but only fine salt is satisfactory for salting butter.

POINTS IN BUTTER-MAKING.

Sound Points—Heed.

1. Pure Milk.
2. Cleanliness, Absolute.
3. Regularity, In all operations.
4. Falling Temperature in Cream-rising.
5. Cream Ripening—*Ripen Equally.*
6. Souring Cream—*Slightest Degree.*
7. Grain—*Preserve it Unbroken.*
8. Churning—*Stop in Time*—When Granulated.
9. Pure Water.
10. Salt to *Suit the Taste.*
11. Packing—Solidity and *Uniformity.*
12. Tubs—Must be New, also Air and Brine Tight.
13. Appearance, Best Possible—Inside and Outside.
14. Trade Connection—Keep it up.
15. Utensils and Supplies, Get the Best.

Unsound Points—Avoid.

1. Uncleanliness and Filth.
2. Impure Odours, Exposure to.
3. Changes of Temperature—Unnecessary Changes.
4. Extreme Temperatures—Low Cooling, High Heating.
5. Ripening Cream Unequally.
6. Over-souring Cream.
7. Injury to Grain.
8. Friction in Churning—Too Rapid Churning.
9. Over-churning—Gathering in Large Lump.
10. Impure Water.
11. Impure Salt.
12. Hand Contact.
13. Over-working, or *Kneading.*
14. Over-salting, Over-colouring.
15. Old Tubs, Poor Tubs.

APPENDIX.

IMPORTANCE OF THE DAIRY INTERESTS.

Present and Future.

"The great strength as well as the great wealth of the Dominion of Canada rests in her soil. Her minerals are of undoubted value, her fisheries are the finest in the world, her manufactures are not insignificant and must continue to increase; yet it is not on these she must chiefly rely for future greatness. She has one attraction greater than all others combined, and that attraction is her broad forest lands and her rich, rolling prairies. *Agriculture* is her strength."—*Handbook of Information—Department of Agriculture.*

"Times have wonderfully changed since the simple days when our farmers depended on their own dairies for their butter and cheese, or, perchance, drew a limited income from the overplus which found a ready market among the neighbours. It was peculiarly a home industry, with little thought of ever becoming of national importance, even surpassing in value the agricultural staples that make the kingdoms of the old world our debtors. But so it has already become in the space of a single generation. The sober fact is stated that the combined value of our butter and cheese exports is $50,000,000 more than that of our wheat crop."—*Illustrated Christian Weekly, 1881.*

"It is but a few years ago that New York supplied Canada and the western states with cheese, because it was then supposed that good cheese could not be made in either place. Now, Canada is not only supplying herself, but is sending to England some fifty millions a year of better cheese than New York then sent to Canada."—*Prof. L. B. Arnold.*

"Within the last few years great progress has been made in Canada in the way of farming. Not long since the cheese manufactured in the country was not sufficient to supply the local demand, whereas there are now cheese factories by the score in the Provinces of Ontario and Quebec."—*Handbook of Information—Department of Agriculture.*

"Facts show that no other branch of farming is really so profitable as intelligent, systematic dairying. Consider the adaptation of our locality to this business, the present high reputation of western butter, and we may safely conclude to engage in the work extensively, confident of profit to ourselves and credit to our State."—*Miss Fannie Morley, Champion Butter-maker of America.*

"Among the interests which it is our duty to promote, the first place must be assigned to *Agriculture*, for although it is not usually considered as included in the terms *Trade* and *Commerce*, its products constitute the largest and most important part of our annual exports, and no apology is necessary for its introduction here.

"It is the foundation on which all our other industries must rest, and its importance is manifest when it is considered that it employs nearly three-fourths of our whole population. The field, the forest, the mine, and the fisheries are our chief natural resources, and it is to their profitable development that we must look for future progress and wealth."—*Toronto Board of Trade, 1882.*

"It is impossible to measure or even estimate the importance of agriculture to a people. It is the basis and source of the permanent wealth of a nation. It is the parent of manufactures and commerce and the foundation of all industries. In the earliest his-

tory of the world the people were devoted to agricultural pursuits, and civilization only took form and shape after the people had learned to till the soil. The Israelites were one of the greatest agricultural nations of antiquity. The Greeks, though possessing a sterile soil, gave great attention to agriculture, and the fact of their being able to grow good crops off their land and naturally unproductive soil gives evidence of their intelligence. The Romans were a nation of farmers. The State allotted to each citizen a certain parcel of land, and he who was not content to own and till the land was deemed a dangerous person to the State and society. Besides the nations whose prosperity can thus be traced to their agricultural resources and the intelligence of their people, reference may appropriately be made to distinguished men both of ancient and modern times who have devoted their talents and their energies to the improvement of this science, and made the occupation a source of pleasure and profit to themselves. Cato, a Roman general and statesman, found time to write books on farming, as well as to actually engage in the occupation. Cicero, the renowned orator, prided himself upon his agricultural attainments. Cincinnatus was a farmer, and was called from the plough to become the chief ruler of his country. Napoleon the First said that agriculture was the body and soul of the empire, and in the height of his glory gave much time and study to the subject, establishing in France a Department of Agriculture. Prince Albert, the husband of England's Queen—he whose name is revered by all British subjects—took a lively interest in agriculture, and said 'that agriculture was the foundation of the social state.' Agriculture is the foundation of manufactures. Why? Because the materials of art are the productions of nature."—*W. P. Page, Ed. Can. Farmer.*

The immediate importance of the dairy industry of the country is small compared to its possible future. The change that has taken place in the immediate past is but an earnest of greater improvement that may follow. Were the country to produce all the butter that by better methods of dairy-farming and dairy-work might be made, and of a quality that the intelligence of the farmers ought to warrant, who doubts but there would be double the present production, and yet that the sale of the whole would be even more sure and at an enhanced price?

But the indirect result of a needed improvement is of no less importance. A realization of such improvement means more. It means better and more profitable general farming. It means the bringing back to heart of our worn-out farms. What a bad system of grain-growing has taken from our lands, an improved system of dairy-farming is going to put back again. This is an important matter, and the minds of leading agriculturists are giving thought to it. At the American Dairymen's Association, held in Jan. 1882, T. D. Curtis, reading a paper on the (American) "North-West," claimed that the wheat lands are deteriorating and will soon become dairy lands. Says Prof. Arnold:—"An approximate certainty of uniform products and prices, a diminution of the severe labour of grain-growing, a cessation of its exhaustion of the soil, and the retention upon the farm of nearly all its fertilizing material to aid in restoring an impoverished soil to a rich and productive one, are considerations which must in the future, as they do now, have great weight in leading intelligent farmers to exchange the plough for the milk pail. They are sufficient to warrant the inference that dairy-farming is destined to follow in the wake of the grain-grower, and, sweeping over the wide expanse of his westward march, to restore the lost fertility and bring back to productiveness the vast extent of land which his destructive habits have made poor. They will make dairy farming preferable to grain-growing when the profits on dairy products shall fall to those of grain growing, and even below."

Says Prof. Arnold again:—"How the usual modes of farming exhaust the fertility of the soil is well known. The stores of plant food which untold ages had accumulated in the virgin soil are sapped away in a few short years of subjugation to the plough. The depleting process seems destined to overrun the whole continent. It sweeps steadily on, keeping pace with the removal of the primeval forests, and leaves everywhere impoverished soils and diminished crops behind it. The exhaustion goes on till the yield is reduced below profitable culture, when some new mode of operating must be adopted."

"It is the universal experience with the best farmers, that feeding the cheap produce of the farm to stock, and selling only the most concentrated and valuable products, is not only

the best means of maintaining the fertility of the farm, but also the means by which the most money is made out of the land. This can be accomplished by growing stock, or dairying, or by combining both in a mixed system of husbandry. When milking can be properly attended to at not too great cost, there can be no doubt that dairying is as yet the most profitable with us. If ever over production should result in unprofitable prices, then the least productive of our milking stock can be readily turned into beef, and stock growing rapidly resorted to. In contrasting the profits of dairying with stock raising, the conclusion is forced upon us that, even at the lowest average prices that have yet prevailed, there is a wide margin in favour of dairy products. The most generous feeding hardly ever produces a gain of 2 lbs. live weight per day. As liberal feeding applied to the production of milk would give a yield from an ordinary cow of 25 to 30 lbs. per day, on an average of the season, this at current rates would represent gross receipts in one case of about 12 cents per day and in the other of 25 to 30 cents, reckoning beef at 6 cents, and cheese at 10 cents. Then only about three months' keep is necessary till the cow is again as productive, while two years' feed is necessary with the best kind of beef stock before they are ready for feeding off. We think these figures ought to be conclusive as to the superior profits of dairying. We are quite willing to admit that the manure from feeding stock is rather more valuable, on account of the extra amount of mineral matters carried off in the milk when cheese-making prevails. Were it necessary to replace these, a very trifling amount for bone dust or superphosphates would suffice, but this may not be necessary for generations yet, if the soil is naturally rich in these elements."—*John Smith, Prize Essay, Ingersoll, 1883.*

TO-DAY'S PROBLEM IN THE DAIRY INDUSTRY.

The opening up of the great wheat country of our Canadian North-West is going to make a new problem for the owners of more or less impoverished lands in the older Provinces. The course of things in the past was a constant diminution in production. Suppose this order of things were to continue much longer, to what would it lead? Simply to this, that the farms in these older Provinces would constantly grow poorer, and the crops smaller and more uncertain, and this in the face of a flowing in upon the market of vast quantities of grain from the prairie lands of the newly-discovered homes for European emigrants. Will the solution of the problem be a continuance in the old course, or will it be a change? Certainly, if change be possible, change it will be. From the dead industry of wheat-growing upon impoverished farms, there will be a pushing forward to profit in the line of dairy farming upon lands yearly growing richer and better, and coming back, indeed, to a state fit for grain-growing again, if need be.

In dairying, the old farms will be able, even with the bad start of worn-out soil, to compete with the North-West. Fortunately, there is enough in the soil, even when it is too poor for grain-growing, to admit of profitable dairy farming if followed upon a wiser system than that which unnecessarily impoverished the land when growing grain. Worn-out lands, by known and easily-adopted methods, may be brought back to heart by keeping stock to profit quite as well as by a large outlay of means (not possessed by the ordinary farmer) applied to the purchase of artificial and expensive fertilizers. On this point, Professor Arnold writes:—"Dairy farming is most appropriate and inviting for the restoration of a vast extent of land thus reduced. It stops at once exhaustion, but does not stop income. It brings good returns from the first. Forage crops grow well where grain crops pay poorly. Seeding down to grass gives time for air and water, heat and frost, to gradually unlock the tenacious compounds which hold the mineral elements of plants as with a firm grasp, and lets them loose for the rootlets to feed upon, or to accumulate in the soil for future use. It gives time for the absorbent properties of the soil to take in elements of fertility from the atmosphere, from the snows and rains, and from the dews of heaven. In this way a farm that has run down may be made to grow rich, and a rich one richer. This problem is often worked out practically by farmers with such satisfactory results as to strongly induce others to 'go and do likewise.'"

This question of impoverished lands and probable North-West competition is [illegible] that must not be dismissed as unimportant or too far off to be at once heeded. T[illegible] minence given to it at Dairymen's Conventions is but one proof of the life of [illegible] The following is a press report of the Convention of 1882 at Woodstock

"The chief points brought out in the banquet speeches were in regar[illegible] the ou[illegible]s future of the dairy interest unless the conditions of inevitable change be n[illegible]:

"Prof. Arnold believed that the standard of quality must be raised, and tha[illegible] prices could even then go down, making it necessary that the farmer cheapen production.

"W. H. Lynch showed that to meet the problem of North-West competition in the face of impoverished eastern lands, we must turn our attention for a time more to dairying, that the dairying must be largely butter-making, and that quality of product is of equal importance with the other object of cheapness."—*Cor. Free Press.*

"If we do not produce cheaper, our people will go west, and your people to Manitoba, where the land is fertile and cheap, and they will send their produce by railway and undersell us at our very doors. The only way we can defend ourselves against competition from the west is to produce milk cheaper than we now do. The soil there is in its virgin purity.

"I know of nothing that stares us in the face to-day more clearly than this western competition. You have got to meet it, and so have we."—*Hon. Harris Lewis.*

There is one redeeming prospect in the general outlook. The opening up of the North-West and extensive grain growing, that will make serious competition with our older districts; the failure of our old farms to respond as usual to the husbandry of the farmer; these conditions may act in conjunction with the growing disposition of our people to learn and do the best, and lead to more extensive dairying, by wiser and better and more profitable methods.

The following having reference to the present condition of farming in Ontario, is from the report of Toronto Board of Trade for 1881 :—

"Agriculture in Ontario is not in so thriving a condition as is desirable; to prove this we have the evidence of the British delegates who visited the country two years ago, and also the report of the Agricultural Commission appointed by the Government of Ontario, which reported last year. This report is a work of very great value, and ought to be in the hands of every farmer, besides having a place in every public library in the country.

"The evidence from both these sources goes to show, that for want of sufficient skill in the cultivation of the soil, and in the rotation of crops, a large proportion of the farms in the early settled portions of the Province, are so seriously impoverished, as to be incapable of producing the quality of grain necessary to command the market; and the quantity produced is also so much diminished as to render the production of wheat an unprofitable occupation. There is other evidence to the same effect. In 1880, the President of the Corn Exchange Association of Toronto, in his Annual Report, said, that the quality of Canadian wheat was so much deteriorated that even if the markets of the United States were thrown open to us we had not the quality of wheat to compete successfully in them; and only last month the same association unanimously passed a resolution to the effect that, the standards of flour and grain recently selected by the Board of Examiners at Montreal, were so much above the average quality of grain in the country as to be useless as standards, and requesting that they be revised, on the ground that it was impossible to furnish either wheat or flour in quantity equal to the standards, and thereby the trade of the country would be very seriously injured.

"This is a very important matter, affecting the interests of every class in the community, and cannot be too often, or too pointedly, brought under public consideration.

"An entire change in the system of cultivation is necessary; and it is a hopeful indication of improvement that cheese and butter factories are being established in many parts of the country. An immense saving will be effected by this means; the enormous waste of milk and labour annually incurred in abortive attempts to manufacture these articles will be prevented, and a quality of goods produced which will be a credit to us, either in the home or foreign market."

Here is food for thought for our far-sighted public men. Without taking a dark view of possible happenings, it is wise to watch the natural course of things and be equal to the need of the situation.

There is another condition affecting our dairy interests to-day. It is the comparatively recent placing upon the market of an artificial product as substitutes for butter and cheese. The influence of this bears in many ways upon the real butter and cheese market. It increases the aggregate quantity of production, and this sometimes has the effect of making stocks accumulate, thus increasing the age of the natural product when it reaches the consumer. The longer keeping of the product, especially butter, because of its perishable nature, tends to depreciate its quality. This result is aggravated where the standard of quality of the commodity when first produced is low, as is the case with butter. Again the general conditions of variable quantities, qualities, supply and demand, favour speculation, and consequent fluctuations of prices, this an effect becoming itself a cause. Proof of the foregoing is hardly necessary to thinking business men who have had any connection with the dairy produce trade of the country. All this is not so true of cheese as of

butter, and it is owing largely to the superior quality of the former and its generally better market conditions.

"I feel, however, that there is a difficulty in reaching the men I wish to speak to. They do not generally attend conventions, and comparatively few carefully read the Report. It may be said by some that *they* are the losers, but this is not the whole truth. Every dairyman is a loser by the bad practices of his neighbour. This is true under all circumstances, and in every community, but especially so under the present system of co-operative dairying."—*F. Malcolm, Prize Essay, Ingersoll, 1883.*

"Looking over the broad acres of this Ontario, we see a country whose owners have not been alive to their own interest, but have in some measure deviated from the signs of the times, and pursued the old and native-born course of continued grain cropping and re-cropping, until the surface of their first cultivated land is in some measure exhausted, and fails to give the return it used to in its new and virgin state."—*Jos. Fisher, Prize Essay, Ingersoll, 1883.*

SOLUTION OF THE PROBLEM.

The time will come that the North-West will engage largely in dairying, but doubtless the first serious competition it will give to the older Provinces will be in grain supplying. If these older Provinces are wise they will make the best of the meantime in establishing their dairy interests on a good footing, and while doing this, to yearly profit, in bringing back their lands to their wonted condition of fertility, and thus be able to compete with even the North-West in grain growing, making possible the normal state of either this special or mixed husbandry.

The problem that presents itself in the dairy industry to-day, will find its solution in the improvement of the industry, in several directions. It is required mainly to aim at the following ends:—(1) A cheapening of cost of production; (2) Increasing the market value of the product. The second is doubtless even more important than the first, and it is certainly more pressing, but we shall treat of the two conditions in order.

"The minerals taken from the soil by the cow can be replaced by bone dust and nitrogen. If the milk goes back to the farm there is very little loss to the soil, but if you are making cheese there is a great deal, and it ought to be supplied, and it will be a mistake for us to go on making cheese without putting it back."—*W. H. Lynch, Ingersoll, 1883.*

"It is the experience of ages in older countries that the fertility of the soil cannot be maintained unimpaired, without keeping a sufficient proportion of the farm in grass, unless extraneous supplies of manure are availed of, which can only be done to advantage in the vicinity of towns. Hence the general system of dairy farming which requires a large area in grass has already wonderfully improved the productive capacity of many of our run-down farms, where grain growing exclusively was too long indulged in. How grass exerts such a beneficial influence in restoring fertility is not so easily explained, but experience has long established the fact of its doing so. The 'rant' that a certain class of theoretical writers indulge in, about the exhaustion of the soil by dairying is all upset by this fact alone. This fact of pasture renewing, or regenerating the elements of fertility in a soil is supposed by some scientists to be owing to the wonderful capacity of the grasses for absorbing carbon and ammonia from the air, disintegrating and decomposing mineral matters, decomposing and assimilating injurious excretions of other plants, and accumulating a wonderful amount of vegetable matter in the thick mass of fibrous roots and leaves. To the practical farmer and dairyman it is immaterial *how* we account for the recuperating effects of pasture."—*John Smith, Ingersoll, 1883.*

1. CHEAPENING COST OF PRODUCTION.

The farmer whether or not he sells his produce at a lower price has an interest in all possible ways of producing at less cost. If competition affects his market he has more than a double interest in the matter, since he must face a problem, which is a far different thing from merely getting lower prices.

What may be done in the way of producing at less cost will be suggested by the following extract from an article by Conrad Wilson in a late American journal:—

"Finally our industrious commentator is anxious to know how it is possible for Mr. Zadoc Pratt, of New York, and Hon. G. W. Boutwell, of Massachusetts, to produce butter at a cost of eight cents a pound. I have already partially analysed some very interesting feeding trials made by these gentlemen, and also other experiments equally instructive by Prof. E. W. Stuart and others, and have published some of the results, from which it was clearly evident that the cost of production for the butter did not exceed eight

cents per pound, though most of the parties had not claimed this rate of cost, and others did not seem to be aware of it."

This is not given to make the claim that butter can be produced at a cost of only eight cents per pound. The object of the writer is not to raise a controversy, but to present the question in all its phases, and give the producer every incentive and encouragement to *work towards* the best result possible. If it be a fact that some dairymen have pro duced butter at a cost of eight or even ten cents per pound, it is for every intelligent, pro gressive dairyman who has not yet attained that result to lose no time in learning wherein he may improve upon his present methods.

"Observe the contrast between the manner in which the merchant and manufactured transact their business.

"Have you not observed with what exactness and care the merchant has calculated every transaction in which he expects to realise a profit? how the manufacturer supplies himself with the best and most improved machinery within his reach, in order to avail himself of the smallest possible fraction of profit to be gleaned from his business? and has it not occurred to you that if dairymen in general would exercise the same degree of precaution and care with reference to all the details of their business, that, as a class, the years as they go by would pour into their laps a much more bountiful reward than that which they now realize?

"We are looking forward to the day when the same degree of intelligence, exactitude, and system will be employed upon the farm as in the counting-room or the best conducted manufacturing establishments of the country.

"Observation and experience are pointing the way in which energetic effort may achieve much better results than have yet been realized in this lucrative and permanent calling, and we have only to make use of the light which they furnish that we may reap the greatest possible benefit.

"As a rule, men pursue the various occupations of civil life for the profit which that occupation affords. Competition has so adjusted these occupations, that it is only to those who have made themselves masters of the trade they follow, and learned to avail themselves of every advantageous circumstance within their reach, that they will yield a profit. As a rule, all the various branches of industry have been narrowed down to a point where profits are reached only by the largest possible production in the shortest possible time.

"For example, flour is to-day produced at a profit of twenty cents per barrel, and that miller who finds himself unable to produce a sufficient number of barrels in a day to reach a profit from this margin, is very likely to soon find his effects in the hands of a receiver.

"In the production of milk in the greatest possible quantity, in the least possible time, by the least number of cows, lies the secret of success. If ten cows can be made to produce the milk of fifteen, he is a poor arithmetician who cannot see that the owner of ten is a gainer over the owner of the fifteen to the extent of the cost of keeping and interest on the value of five cows.

"That this profit is actually realized by some sagacious farmers over their less wise and less economizing neighbours, scores of cheese factory men will attest.

"To me it seems one of the most singular freaks of human nature that a man, apparently intelligent and in his right mind, will keep and feed in his dairy a cow giving but eight quarts per day, which will consume as much food, occupy as much space, and require as much attention as her sister in the next stall that gives fifteen quarts.

"In my journeyings here and there in various sections of the Dominion of Canada, I have been struck by the frequent recurrence of phenomena of this character. I have too frequently observed dairy cows wandering over grassless pastures in search of food, and I have wondered how the owner of these animals could so lose sight of his own interests. I have seen the herd standing hours together, with their rumps toward the bleak December storm, their attitudes telling, louder than words, the discomfort and hardship of their situation; and I have asked myself the question, Why will a man be such a fool? I have wondered why men will allow acres of pasture land to lie practically unproductive, when small outlay of labour and money invested in seeds would more than treble its productiveness. I have seen a man wasting his time ploughing with one horse, and have

wondered how he could have lived so long and had never learned that two horses, costing but little more, would more than treble the effectiveness of his efforts."—*J. B. Harris.*

"Farmers are more and more coming to see the necessity for keeping stock of some kind in order to keep up the fertility of their farms, and although raising horses or feeding beef cattle may be carried on profitably by many, neither is so well adapted to the necessities of a large class of struggling and hard-up farmers as keeping cows. We all know of many cases of men who, previous to becoming milk producers, were in the greatest straits to meet interest on mortgages and other incidental expenses, who have found great relief from dairying. We also know that in no part of the country is land higher than in the dairy section, and in none is there a greater appearance of prosperity. No other kind of farming has been tried that would yield a profit with such *certainty*, neither do we know of any that does it as *quickly*. These facts, as they become more and more apparent, will not only give greater confidence, but will make the dairy what it should be—*a greater specialty*.

"There are comparatively few really dairy farms in the country, most farmers being afraid to rely solely on one thing. I know that mixed farming is generally recommended, and it may be the best under certain conditions of agricultural development, but it is not the highest. There is a law underlying all highly developed commerce and mechanism that forces them into certain lines. This tendency is more strongly marked in the Old Country. From Paisley we get our thread, from Sheffield our cutlery, etc. We notice this law rapidly making its way in this country, not only among our merchants and mechanics, but in agriculture. One section of country is becoming noted for beef cattle, another for heavy draught horses, another for its large quantities of excellent barley, and another for its cheese. It will at once be seen that if those localities should run their specialities to a higher degree of development, there would be an advantage to both buyer and producer. This law is not confined to communities, but extends to the individual. We know it to be a fact that ten cows do not take double the care that five does, or twenty that ten does. It is a well-known fact that it pays better to do one thing in a large way, than many things in a small. Whatever benefits the individual benefits the community, and *vice versa*. I have known many who had to take three-quarters of a cent less for a gallon of milk than I did, simply because there were not enough of cows kept in their community.

"One difficulty in the way of getting fully the advantages of concentration and co-operation is the fear that prices might fall below a paying point, and it is thought 'best not to have all the eggs in one basket.' On this I would remark, that there is just one question that needs an answer in the affirmative to settle it with me. Are we favourably situated as to the conditions necessary for successful dairying, such as temperature, soil and water, in comparison with other portions of the dairy world? If we are, there is no need to fear. Good cheese will continue to be consumed, and the full cost of production paid for."—*F. Malcolm, Prize Essay, Ingersoll, 1883.*

In what ways may the cost of milk production be reduced? First, by

Improvement of Stock.

Mr. Evans in *Dairyman's Manual* (1851), gives the result of a number of experiments made by a Mr. Holbert, to test the butter value of the milk from twenty different cows. The number of pounds of butter to each one hundred pounds of milk was as follows:—2·5—2·94—3·22—3·22—3·31—3·33—3·7—3·8—4—4·5—4·5—4·8—4·14—5·2—5·4—5·8—5·8—5·09—6·1—6·2.

"The produce of these twenty cows ranges from two pounds and five-tenths, to six pounds and two-tenths of butter, in one hundred pounds of milk."

An average yield is four pounds. Six cows give about the average; seven cows give more than the average, and seven cows give less than the average. The general average of the whole twenty cows would be 4·37 pounds. This is a better showing than most of our dairymen make to-day, but it is most important to notice that what one-third of the cows gives in quantity over the average, *goes to make up the deficiency in the quantity given by the same number of the poorest cows.*

It is to be feared things have not much improved since the above experiments were made, over a quarter century ago. The Hon. Harris Lewis claimed last year (1882), at Woodstock, a similar state of things. "One-third of the cows in the County of Herkimer, N. Y.—the old banner cheese county in the world this side of England—that one-third of the cows there failed to pay their keeping; about one-third will balance the books, and one-third they receive a profit from; that is, one-third of the cows kept, pay up the loss sustained on the other third and leave a little margin of profit."

Selection and Breeding.

The leading points in determining the kind of cows a farmer should aim to keep will be his location and means, and the use he intends to make of his animals. He will always have in mind the greatest economy consistent with the largest results. The intelligent dairyman, in short, will have his ideal of what is best suited to his place and purpose, and he will aim to attain as near to that ideal as will be profitable, when considering cost and results.

The dairyman, therefore, must select the best he can find, at a cost within the range of profit. The best of all, doubtless, are the pure breeds that, by breeding successive generations, have thoroughly established in them the milking habit. But the great cost of the best of these breeds places them without the range of profit. Since the "milking tendency may descend as readily through the males as the females," by the careful selection of the best native cows, available *grades* may be obtained whose merits as milkers are high, and whose cost will be within bounds. Where grades are not available, selection must be made from common stock. As there is a limit to the price one may pay for a high-class animal to make any profit out of it, there is also a limit to the employment of the poorer class of stock, at any price. If a cow be too high-priced, it may be that her yield of milk will not leave any profit over the proportion of the investment chargeable to each season, taking into account interest on original cost, and risk of accident or loss proportioned to estimated value. On the other hand, a cow that costs little or nothing, may not give milk enough to pay her keeping. The dairyman has his farm and stable-room, appliances and labour for a certain number of cows; the profit on these cows is his living. If a cow has cost so much that the profit is little or nothing, or if a cow is so cheap that she is loss rather than gain in the dairy,—in either case she takes the place of one cow in the limited complement and deprives the dairy of legitimate revenue.

Yet if there be any choice between the two extremes it is in favour of high-priced stock, at even a "fancy" price, for the breeding qualities will tell upon the future stock of the farm. And the means that is likely to make the dairy a running profit while steadily improving stock is, without doubt, the use of *grades*.

The peculiar characteristics of an animal are of two kinds, *breed* and *individual*. The breed characteristics are something of a permanent nature, long established in the blood through successive generations. The longer it has been in the blood the greater the power of hereditary transmission. The individual characteristics of an animal are something of an accidental nature, coming of immediate condition of the parents, or other like temporary conditions. These characteristics are short-lived, and easily lost, unless transmitted under favourable conditions (of individual vigour, etc.), becoming stronger with each direct transmission.

"By breeding animals of a similar type the offspring will be likely to possess the same characteristics, with a greater power of hereditary transmission of this character or these characteristics. On the other hand, animals of opposite characters mutually weaken each other's influence, and the offspring possesses the power of hereditary transmission in a reduced degree."—*Professor Wetherall.*

Flint writes in this connection:—"The grade animal may be a very fine one, but it has been found that he does not transmit his good qualities with anything like the certainty of a pure-bred one. The special reason for the use of a pure-bred male in crossing is not so much that the particular individual selected has these qualities most perfectly developed in himself, as that they are *hereditary in the breed* to which he belongs. The moment the line is crossed, and the pedigree broken, uncertainty commences. Although the form of the grade bull may, in individual cases, be even superior to that of his pure-

bred sire, yet there is less likelihood of his transmitting the qualities for which his breed is most noted; and when it is considered that during his life he may scatter his progeny over a considerable section of country, and thus affect the cattle of the whole of his neighbourhood, attention to this becomes a matter of no small public importance."—*Dairy Farming, 1860.*

From this it will be seen that grade animals are "more liable to fail in transmitting their individual characteristics than are thoroughbreds. It is safer in raising grades for milkers to resort to thoroughbred males for sires." So the milk producer may, within the limits of means and circumstance, by degrees get himself supplied with good milking stock, by raising grades from "his best cows out of bulls of the breeds best adapted to his use."

The dairyman, in the selection of his herd, must consider whether the object in milk is quantity, for sale in its natural state; or quality, for butter or for cheese. He will doubtless have a regard to the fattening properties of his animals, that when past milking to profit, they may be allowed to go "dry" and be fed for beef. This last requisite, however, must needs be of secondary importance. A good dairy cow should milk to profit not less than ten years, and it will be no object to have that profit appreciably diminished for the sake of a fattening quality that will add a few dollars to her value only at the end.

The dairyman who, with moderate expenditure of time and means, would succeed in getting himself a herd of high-class cows well adapted to his soil and specialty in production, should make this branch of the subject one of careful study. All that space will admit here is the noting of (1) the main principles of breeding, and (2) the special characteristics of the more approved pure breeds.

How to Select Cows by External Marks.—The remarks of Prof. Arnold on this head are so sensible and practical that they are well quoted here entire:—"Milk is a female product, and its production may reasonably be expected to be more or less affected, if the organization varies much from the characteristics peculiar to the sex. First of all, see that the animal has a feminine appearance—a cowy look. The next thing to be looked after is the digestive apparatus, particularly the stomach and bowels. A large and strong boiler are not more essential to the power of an engine, than a large and vigorous stomach is to the production of milk.

"When the digestive organs are relatively larger than the other viscera, they give depth and breadth to the abdomen, and a somewhat wedge-shaped form—the body tapering forward.

"The large stomach and bowels here indicated, mark a diathesis in which the fluids abound—a condition very essential to a large flow of milk; and the broad hips, and the depth and breadth of the lumbar region, indicate a large development and flow of blood, and vital influence to all the parts surrounding and connected with the milk-producing vessels. Gaunt cows are small milkers.

"A good constitution is important. This may be judged of by the lustre of the hair and the brilliancy of the eyes and horns. Constitution depends mostly upon the heart and lungs, the size of which may be determined by the depth and breadth of the thorax. They should have a good development, enough to secure health and vigour, but the lungs, in particular, should not be excessively large. When very large they burn up, by increased respiration, the fat-forming material. By the extraordinary energy they create, they induce unusual exercise and motion, which make a rapid waste of tissue and a rapid assimilation to repair it, and thus divert nutriment from producing milk. If too small, the animal may be an excellent milker while she lives, but will be feeble and short-lived.

"The capacity of the lungs corresponds with the size of the apertures through which they are filled. Large open nostrils indicate large lungs, and *vice versa*. In the same way the indications of the mouth correspond with the size of the stomach.

"The chine is regarded as an index to milking capacity. Whan it is double it denotes breadth of vertebræ, which correspond to the broad open structure which is favourable to a large flow.

"It is an accompaniment of broad hips, and these in turn denote a large cavity which is essential to good milkers.

"The milk mirror, or escutcheon of Guenon, is one of the leading indications of milking capacity. It consists of the peculiar appearance of the hair on the udder. Looking at the hind part of the cow, more or less of the hair which covers the udder and adjacent parts, will be seen to turn upward or outward. This reversed hair forms the so-called escutcheon. If the space occupied by the upturned hair, especially the lower part of it, is very large and broad, so that it extends far outward on to the thighs, it is regarded as indicating a large flow of milk. If the upper part of it is broad and smooth, it is regarded as favourable to a prolonged flow. If the reversed hair is narrow in its lower part, the flow is supposed to be small; if it is narrow and irregular in its upper part, it is unfavourable to a prolonged flow. The manner in which the inverted hair connects with the hair adjacent, is supposed to have significance. A gradual blending, rather than abrupt connection, is preferred.

"The connection of the escutcheon (or scutcheon) with the flow of milk, is accounted for by Magne, who says, that the hair turns in the direction in which the arteries ramify, and that the reversed hair on the udder and adjacent parts, indicates the termination of the arteries which supply the udder with blood. When there arteries are large, they are not confined to the udder, but extend down through it and upward and outward, ramifying on the skin beyond the udder, giving the hair the peculiar appearance which distinguishes it from the rest of the surface. If the arteries supplying the udder with blood are very small, they are not likely to extend much beyond the udder, and hence form a small escutcheon. Hence, a small escutcheon indicates a feeble supply of blood to the udder, and consequently but little material to make milk of, and hence a small flow of milk.

"Guenon studied and explained these marks only as they appear on the hind part of the bag, and the marks noticed by him were supposed to apply to the whole udder. This could not well be true. Each quarter of the udder is supplied with blood by a distinct and separate arterial branch, and they may, and often do, vary considerably in size in the respective quarters of the bag. Those supplying the two hind quarters of the bag are usually larger than those which supply the front part, but sometimes the reverse is true, in which case the marks on the back part of the bag would not be a correct indication of the front part, and so with other inequalities. Each quarter of the bag has an escutcheon for itself, made by the ramifications of the arterial branch supplying it with blood, and which serves as an index only to that division of the udder. These mirrors blend in the middle and serve as one, but the outside of the reversed hair varies for each quarter according to the size of the arterial branch by which it is supported. Cornelius Baldwin, of Nelson, Ohio, who has studied milk marks very closely, gives as much significance to the mirror on the front part of the bag as on the hind part. If there is more escutcheon on one side or one quarter of the bag, it indicates a flow from that side or quarter corresponding to the excess of the development.

"The size of the escutcheon is regarded as the measure of the quantity of blood supplied to the milk-producing vessels, and are evidence of their capabilities of elaborating milk. In the same way, the veins take up the blood and carry it back in the milk veins, which pass through the bag and along the belly, and enter the body through one or more holes on their way to the heart. The size of these milk veins and the holes where they enter the body vary with the escutcheon, and like it give evidence of the quantity of venous blood passing away from and through the udder, and they have the same significance with reference to quantity, as the supply of arterial blood and the size of the escutcheon.

"But none of these indications, taken singly, is an infallible evidence of large yield. They must be considered together. A large escutcheon and milk veins, coupled with a small stomach, would be marked down at least one-half of what they might otherwise signify, and a large digestive apparatus, coupled with small milk veins and escutcheon, should be marked down in the same way. Keeping the leading indications in view, observation will soon enable one to make close estimates.

"Soft, fine hair is by many regarded as an evidence of richness, and oftener than otherwise it proves true; but some cows that give the very richest milk have hair that is not so very fine and soft.

"The appearance of the skin is another guide. A clear white or pale skin is another evidence either that yellow fat is not formed, or, if formed, the peculiarities of the animal are such that it is used up in supporting respiration. When it is so abundant as to lodge in the pores of the skin and give it a yellow colour, it may be expected to appear also in the milk and give it the same colour. High colour and richness seldom fail to go together—hence, a yellow colour becomes an evidence of rich milk; but it sometimes happens that the skin is of such a hue that the yellow fat does not affect its colour; in such a case, appearance of the skin has no significance. One of the best indications to the richness of the milk is the appearance of the inside of the ear. If that is yellow and sheds a yellow dandruff, rich yellow milk is sure to accompany. The same is true in regard to the twist.

"The fat of animals is stored in a network of cells, called cellular tissues, and an abundance of these cells is coupled with a tendency to form fat wherewith to fill them. When the cow is in milk the fat formed is carried away in the milk, making it rich. Hence, where this tissue abounds, rich milk may be expected. When dry, the cow having it fattens rapidly. The supply of cellular tissue may be known by feeling the skin. When it is plentiful it forms a sort of cushion under the skin, giving it a soft and mellow feeling. When it is wanting, the skin feels hard, and the hand when resting on the animal feels very much as if resting on the bare bones. A soft, velvety feeling of the skin on the rump and ribs is a strong indication of adipose tissue in abundance, which promotes ready fattening and rich milk.

"A bottle-shaped bag is favourable to richness of milk."—*American Dairying.*

It is in place here to give the suggestions of a few authorities in connection with this part of our subject.

"The milking qualities of our domestic cows are, to some extent, artificial—the result of care and breeding. In the natural or wild state, the cow yields only enough to nourish her offspring for a few weeks, and then goes dry for several months, or during the greater part of the year. There is, therefore, a constant tendency to revert to that condition, which is prevented only by judicious treatment designed to develop and increase the milking qualities so valuable to the human race. If this treatment is continued through several generations of the same family or race of animals, the qualities which it is calculated to develop become more or less fixed and capable of transmission. Instead of being exceptional or peculiar to an individual, they become the permanent characteristics of a breed. Hence the origin of a great variety of breeds or races, the characteristics of each being due to local circumstances, such as climate, soil, and the special objects of the breeder, which may be the production of milk, butter, and cheese, or the raising of beef or working cattle."—*Flint.*

"The improvement in the breeds of cattle is largely due to feeding. Whatever one gets from an animal means so much food. Every pound of milk represented so much food, and that was the best breed of cows which would eat the most and yield the most.

"Every farmer could produce a breed of cattle for himself by crossing the best animals he could get, and continuing to do so. One thing was settled, namely, that the male must be used to produce variation."—*Prof. Stewart at Belleville.*

"A good milch cow is one that has, first of all, good digestive organs. A cow that does not digest her food well is almost invariably a poor milker. 'These organs,' says a well-known writer, 'have a powerful influence on the exercise of all the functions, and particularly on the secretion of the milky glands. A good state of the digestive organs is evinced by a belly of moderate size, with yielding sides, a large mouth, thick and strong lips, a good appetite, easy and quick digestion, glossy hair, supple skin, with a kind of unctuous feel. The constitution should be sound, and this is implied by large lungs, a broad and prominent chest, a somewhat slow respiration, and a great inclination to drink—an inclination stimulated by the abundant secretion of milk.' What is known as the 'wedge shape' is desirable in milch cows. The head should be small and fine, small neck and shoulders, bones small and fine, small eyelids well divided, but not wrinkled, prominent eye, and a kind, gentle look, hips broad, hind quarters large, veins prominent, udder fine and well developed."—*New South Wales Agriculturist.*

"One subject that is always interesting to us is how to cheapen the cost of milk. I think this is a problem which we must all meet sooner or later, because farming on high-

priced land and paying big wages rather makes it a necessity for us to cheapen the cost of milk. *Can any one in this Convention tell me what his milk costs him to produce it?* I think the milk costs every person more than it need cost him. I advise more care in selecting our herds to produce the milk, and not keeping a cow unless she will pay for our keeping. The proper way to select the best cow is to weigh the milk, not measure it and then guess at it. Have regular times for weighing the milk.

"By selecting cows we can do a good deal; by breeding we can do more. Select a male of the breed best suited to your wants, and raise your own cows. There is a good deal of advantage in rearing your own stock. In the first place, it is acclimated, is well acquainted with the herd with which it runs, and is well acquainted with the land over which it travels. Cows acclimated and adapted to your wants are more contented than strange cows, and less liable to accident and injury."—*Lewis at Woodstock, 1882.*

"I like a cow with a slim head and neck, and wedge-shaped from the nose to the hind end, with deep cavities on either side of the back-bone, and a large milk vein. These marks indicate strong physical development. I dislike a heavy head, neck and back."—*Lewis.*

"There are many breeds of cattle, and many of them have been bred for special branches, like the Jerseys for instance, which have been bred for butter-making and for their beauty of head and face, and I guess their owners will come off best by cutting a hole in their barns to let their Jerseys poke out their heads and hide the rest. The Devons are splendid for butter, and for oxen are not to be beat, for you can match them from head to tail; in fact, they are so much alike, that they can hardly tell which is which themselves. If you want butter, take one or other of these breeds. If it is for cheese you want cows, select the Ayrshire and its crosses with your native cows. The pure-bred Ayrshire is a good business cow, if you can get her with large enough teats. See that your cows are kindly treated. If I had that hired man Mr. Harris spoke of, I would put him under the pump and pour water on him until I drowned him in his boots. If you are not afraid of a flood and can milk them from the high side of the hill, take the Holstein, which has been known to yield 18,000 lbs. and over in the year. You will find that all those cows which give the extraordinary yields you read of, need plenty of good food—more than a farmer who keeps them for profit can supply. Whatever breed you favour, get a pure-bred sire and use in your native breeds. Remember, the bull is half the herd, and you cannot afford to use a poor sire. I think the Ayrshire or her grades will do best in this section. And here let me give you an idea of the effect of good feeding. Take one of your native cows and feed her as is done with fancy breeds, and your eyes will stick out of your head like two field onions at the result. In your selection of a bull, consider what you want, and suit the branch of dairying in which you are engaged. If you are going to make butter, choose breeds noted for butter; if you are going to send to the cheese-factory, you want milk that will yield plenty of curd and weigh well. To get good milk and plenty of it, it is of the first importance that you have an abundance of food for your cows."—*Lewis.*

"Peter Gardiner said he derived his best milkers from an Ayrshire bull left at his place by the Agricultural Society. By improving the native cows by better feed and treatment they also increased their flow of milk. He was asked if the increase in milk was not owing to the change to good care for his cows, and not to change in breed. He answered that he found that, with the same care, feed, and treatment, the purebreds are first for profit, the crossbreds second, and the natives last. This applies to the average, not to individuals. He said, moreover, that while he kept all the pure-bred heifers, he reared only the best of native heifers."—*Dairymen's Convention, Huntingdon, Que.*

Crossing Common Stock with Thoroughbreds.—"As a general rule, however, the dairyman must rely upon the common stock of the country on the one hand and the thoroughbred bull on the other, for the base of his operations. It is useless to talk about the exclusive introduction of pure thoroughbreds to meet the present wants of dairymen. The animals would be altogether too expensive even if it were possible to find them. Again, it may be doubted whether any advantage would be gained in the mere production of milk, over a judicious crossing of common stock with thoroughbreds. The grade animal, as a milker, may prove equal to or even

superior to the thoroughbred. It may be better acclimated and, as a rule, is more hardy. Losses are constantly occurring from time to time in every herd, from accident and disease. A portion of the herd must be turned off for this reason and on account of age. The only practical course, therefore, it would seem for the majority of dairymen is, to start with a good herd of native stock, using a thoroughbred bull, and breed up to the qualities desired. In saying this, I do not object to the breeding of thoroughbred stock on dairy farms; that may be done, and may be found advisable; but I would commence at first in a small way, extending the business by degrees, as found profitable."—*Willard.*

"Of cattle, the inquiry is often made as to breeds, concerning which no definite answer can be given until the inquirer be interrogated as to the character of the soil of his farm, its location in respect to the market—what cattle are kept for, whether for beef-making, butter-making, cheese-making, or milk-making, for the city or village markets. If quantity of milk regardless of quality be desired, select Holstein cows; these are good for milk supplies; for cheese, the same race has a good reputation. The Shorthorns are farmers' dairy cows for both butter and cheese.

"If butter-making be the branch of dairy-husbandry prosecuted, Jerseys and Guernseys should be selected as having probably no superiors, or equal even; if beef be the end in view with good working oxen, Shorthorns and crossbreeds of this breed have no equals, though the Herefords are sharp competitors for these honours. The Polled Aberdeen Angus rank high as beef animals, and have been called Shorthorns of Scotland.

"The Fifth Annual Fat Stock Show at Chicago last November, as reported by the *Breeders' Gazette*, caused the Shorthorn breeders and exhibitors to be jubilant. The king of the cattle walk was J. D. Gillette, of Elkhart, Ill., who exhibited cross-bred Shorthorns, to which were awarded the first prizes.

"Mr. Gillette feeds his cattle unhoused, and they are fed with corn in the ear, thus saving toll for grinding with the travel to and from the mill, a fact worthy a special note; another is that Mr. Gillette, with his cross-breeds in competition with thoroughbreds of the same breed, should have been the great prize-winner, not only at the last show but at all the former shows of fat cattle, they ranked as the best. For rapidity of growth and maturity no other breed ranks so high as the Shorthorns; for working oxen and beefing at the end of their usefulness, no other breed ranks as high.

"Of the large breeds, Shorthorns have no superiors, and of the small breeds the same claim is rightly put in for the Jerseys. I regard the Shorthorn race as the aristocracy of the cattle-kind, and conditions and adaptability of soil and forage where they are to be kept, as already stated, must ever and always be kept in mind, in case of selection for the farm. So in respect to all other kinds of the live stock of the farm named above, concerning which I have not time to comment further on this occasion."—*Prof. Wetherell, Brockville, 1883.*

"Taking all things into consideration, I am of the opinion that cows with an equal mixture of Shorthorn, Ayrshire and Jersey blood would be the best dairy cow, and consequently the best general purpose cow for this part of the country, it being better adapted to pasture and hay than to the production of grain and roots, although I believe that the dairying system practised here for the last twelve years has doubled the productions of the soil."—*McNamee, Brockville, 1883.*

"First of all I desire to place on record that there exists no such thing as a *general purpose cow*, as understood by many of us. There is no breed of cattle that will fill the butcher's stall, the milk pail, the cheese vat, and the butter can, as each should be done in these days, and must be done in order to the desired success. That some can do so to a greater measure than others we know, but that any one can, or ever will do so, and aggregate equal to the average of breeds, is just as certain as that cheese is not always cheese.

"Gentlemen, even the world's work of these times is *specialities*, and not the one man fit to do many things well. Agriculture is speedily and surely dividing herself into grain, flesh and wool, cheese and butter.

"No two perfect and distinct products as *now required* can be got from any one breed of cattle or sheep under any sort of conditions anywhere, however favourable. I challenge any gentleman present to name a breed of cattle or sheep that gives an annual produce of two things equal to the like class of things from two separate breeds that I

will name. This provision of nature cannot be disturbed by all the science and art of man, and yet few things speak of the 'Great Balancer' so beautifully as the well-known fact that when we give proper market value for all the points of all classes of live stock, no one set of them overtops any other to any material extent; thus then, it is knowing what we want and securing it.

"The question for Ontario in regard to adaptability of breeds is not exactly what characterizes them in their own lands, but what they are able to do after years of trial in the district requiring them. No influence is so strong as climate; food with Ontario is not a matter of any trouble, comparatively, but the ability of individual breeds and animals to withstand the extremes of temperature in the great regulator of settling down to business. Of course there are in every breed certain inherent properties that cannot be driven out by any form of unsuitability, whether climate, food, or management, and consequently we can build upon their perpetuation in a new land with almost unfailing certainty, yet other things submit to physical condition—invariably deteriorating, rarely improving.

"Ontario has had sufficient experience of several breeds to place them exactly either for beef, milk, cheese, or butter, and yet we are weak in knowledge of others that hold a good name in other countries. I refer particularly to the Holstein and Guernsey. Your Experimental Farm should be in possession of these in view of information similar to what I am about to submit.

"What are the requisites of a first-class dairy cow, is the question before us in this enquiry. Men differ in their likes of individual animals for particular purposes, and much of this will be found to arise from experience under various conditions—that such and such a stamp of cow has done well or poorly with either, where food, management, and the particular class of farm also differed. We forget this too often in comparing notes. The cow we want in Ontario for the dairy, or an average of all influences, should combine the following qualities:—

"An early maturer and breeder, giving her first calf when two and one-half years old, not to be a full milker before calving, necessarily, because of more trouble and deaths; a particularly warm-hearted mother is not wanted. A whole week is sometimes lost by fretting: breeds and individuals differing very much in this regard. We want both quantity and quality of milk for the dairy and creamery; the cow must be a free milker, as in a herd of fifty the loss of *time* alone in one season would amount to actually *twenty-five days*. We should have nothing to do with a vicious cow, whatever her other points may be, as temper affects the very *quality* of the milk, not to speak of the other drawbacks. Commend me to the cow that chews her cud when a sore teat pinches. We want at least twenty pounds of milk per day, on an average, for two hundred days a year. A strict culling out to even this moderate standard would surprise us as a province. We hear often enough of the maximums, and sometimes of the average per season, but never of the minimums. I am an utter unbeliever in specific gravity as a true indication of milk quality, and I have tried it by nearly three thousand observations on ten different breeds of cows within the last three years. More than this I do not require to say at present. Neither is the *bulk* or volume, usually called per cent., of cream of much significance. The weight of the cream from one hundred pounds of milk is the proper criterion, and our model dairy cow should always give eight pounds to the hundred. Then, again, nearly one-half of that cream should be butter—a high standard, no doubt, but as several items that go to make rich milk are largely in our hands, such a proportion can be attained unquestionably. I submit to this Convention rather than to my own experience what cheese should be got from every one hundred pounds of milk. If I said eleven pounds, or nine only, I might be asking what the management or the cow may not be able to influence.

"All these desirable results require a certain machine which we call a cow. Now, just as we build iron and wood to do certain kinds of work, we find in nature most clear evidence of cow machinery, usually called breed, and individual constitution, making very different milk from exactly the same materials, under precisely similar conditions. A glance at the facts need leave no doubt on this point, but of this more to follow, and meantime for construction of this machine. What is the make-up of a model dairy cow?

Some remarkably good cows seem to bid defiance to all sorts of standards of points, but this does not militate from the value of aiming at a standard that is known to average all the virtues of cow life.

"The great beefer of the world, the Durham, is neither a heavy nor a long milker, comparatively, on an average, although some individuals, in the experience of most breeders, are remarkable in both qualities. In the days of their early history, they were unquestionably deep and true milkers, but management towards a different object has, during the last eighty years, changed their dairy standard. Though low in specific gravity, the proportion of cream is high, and the quantity of butter from milk the highest of what is illustrated, and possibly second only to the Jersey, which, as yet, we have not had opportunity to investigate *thoroughly*. Even in cheese the Shorthorn is among the best. With their high average we would expect similar characteristics by the use of this breed with the native cows of the country, whether one or more crosses, but the facts show no advantage in richness, though a very large increase to the quantity of milk, and duration of the season. This Shorthorn grade is undoubtedly the nearest approach we have to what is termed a general purpose cow.

"In duration of season and quantity of milk, the Aberdeen Poll is not equal to the Shorthorn, with which, as you know, it is comparable as a beefer, and indeed it is the lowest of any in quantity, yet giving by specific gravity the richest of all excepting the Devon. But in fact nobody would look to the Aberdeen Poll for the dairy, though when put to the Canadian, we obtain much more prominence in milking powers with a distinct reduction in per cent. of cream, and yet, curiously enough, a fully better weight of cream.

"The great beef grazier of England, the Hereford, is in no ways better than the Shorthorn and Aberdeen Poll in milk quantity, but of any in our experience giving the largest amount of butter from cream—fully one-half, weight for weight. Its grade is very prominently in advance of it—particularly so in proportion of cream, though one of the lowest in cheese properties. I find on reference to a recent live stock text-book published in England, that the Ontario Experimental Farm is credited with placing the Hereford grade as a creamer.

"Note, thus far, in disposing of the three greatest beefing breeds of the world, that value in fair measure could not be got except from the Shorthorn grade, $25 on an average of things, and $20.50 from the Hereford grade.

"In all our experimental research, no breed can touch the Devon in registering a high specific gravity and weight of cheese from milk—both are unusually high, and should be accounted for by the dairy expert. I now ask for this explanation. The Devon is also a good average in duration of milking, and, for its size, fair in the quantity of milk, and over an average of things, gives $25 per annum. Hence, possibly, the cause of its patronage in the States.

"Scotland's hardy beef grazier—the Galloway—has made in our comparatively small experience of it, at least one unusual record as a milker. I refer to the two per cent. of cream, which of course is a low proportion, but it must be explained that the line between milk and cream was a very indistinct one. Much cream stood below this line and always rose slowly, and much never separated from the milk—evidences, I believe in any breed, of rich milk, so judgment in this case should be cautiously handled.

"We have thus gone through what may be called the mixed field of beef and milk, and found but one example that would meet the dairyman's order.

"The Ayrshire is unquestionably a heavy milker—long as well as deep, and on an average will give five times her own weight in milk per season. Observe the somewhat low specific gravity of it, however; and indeed I may ask here how it is that all our true milkers—the Ayrshire, Ayrshire grade, Jersey and Canadian—record an average specific gravity of exactly 100, as against the prevailing high record of the beefers and their grades? From five to thirteen per cent. is a big difference in this respect. It does not mean thinness, necessarily, for want of cream, as in skimmed milk, gives a higher specific gravity, and pure cream, as you know, will go as low as 50 and 30. The Ayrshire does not give cream, however, but stands above the average in cheesyness. Thus, then, with its great quantity of milk, we get an average value, supposing we desire to obtain a milk, cream, butter and cheese mean of $38 a year, and by a specialty, as in cheese alone, of $58 a year.

"The Ayrshire with the Canadian making its grade, is not improved in any respect in our experience, except one, that is, it continues longer in milk, making, however, a well-balanced dairy cow, on the hardy side, and suitable for some of our districts.

"And now what about the world's great creamer—the Jersey? The great point of this breed is that one-third of its milk, both in volume and weight, is cream, and so, on the basis of valuing milk at ¾ cents per lb., cream at 5 cents, butter at 20 cents, and cheese at 10 lb., the Jersey equals the Ayrshire in giving $57 per annum. We have no experience of butter from Jerseys, but allowing the average of 44 lbs. of butter from the 100 lbs. of cream, as in our experiments, the Jersey would give $88 for butter according to ordinary price.

"It is not because the Canadian cattle—if there be such a thing really—are native only that they are placed last in this list. I contend, without any fear of being unseated, that by a proper selection of this class of cows, we obtain a higher annual produce for our ordinary dairy purposes than from any other in this record, and that they are best adapted to the present system of management. As a natural result of general agricultural progress—not special progress always—this special class of cattle will gradually disappear, and unless we supplement with something else—perhaps the Holstein, the Guernsey, or may be a less beefy stamp, by careful selection, of the Shorthorn grade, our dairy interests will suffer. I claim for what is called the Canadian cow, a better defined position, and a higher status than has hitherto been accorded to her 'pedigree' as well. 'Blood' is good, but *milk* at a Dairy Convention is better than either of them."—*Prof. Brown, Ingersoll, 1883.*

"On this subject dairymen differ in opinion—some favouring the Ayrshire, others the Grade Durham.

"The Ayrshire has a high reputation as a cheese dairy breed; but there are reasons that have brought the Grade Durham more prominently to the front, the principal of which is their adaptability to take on beef, in the case of accident or old age. They are the popular cattle of the country, and it would be more expensive and troublesome to keep up a herd of Ayrshire than of Shorthorn grades. So thoroughly has this breed become established that dairymen generally use them, whatever their opinion may be in regard to their merits.

"It will be better to take into consideration the best means of improving, and caring for, the breed we have. But here a great difficulty arises. The Shorthorn has for generations been bred with sole reference to beef. The thoroughbred bulls of the present are no exception, and dairymen when purchasing are generally satisfied with a well-formed animal, without making inquiry as to the milking qualities of the mother. In fact bulls from a good milking strain are the exception. Few could obtain them, even if they tried. With such a state of things it seems impossible to improve the milking qualities of our herds, except there are introduced male animals from some breed where milk has been the object in breeding, and probably none would equal the Holsteins for this purpose. But the expense would be so great that few individual dairymen could see their way through it. I can see no better way by which this cross might be tried than by co-operation. If, say, ten farmers would join together, the cost would be light, and each might put as many of his best cows as he cared to raise calves from. Such calves would be valuable, whether bulls or heifers. The bulls when eight to ten months old, if well fed, should bring from 25 to 40 dollars each. I throw out this idea in the hope it may cause discussion and thought on the subject, and eventually improvement in our system of breeding."—*F. Malcolm, Ingersoll, 1883.*

"Carefully conducted experiments seem to decide that large cows are more economical in this respect than small ones. There is great diversity of opinion as to which breed is the best for milking purposes. The Jerseys have the reputation of yielding very much milk that produces much yellow butter, but in too small quantity to be profitable at ordinary prices. The Ayrshires are a good breed for ordinary purposes; but our most successful dairymen claim that a well-selected herd of native cattle is more profitable for ordinary purposes than any of the pure breeds that are yet available. As all dairy herds, however, need continual weeding out on account of age, defects, or injuries that impair

the milking properties, it is a decided advantage to have an animal that will fetch at least as much for beef as will replace her with a good milker. To accomplish this, and at the same time have good milking stock, a cross with the Shorthorn has proved most successful. Those who have tried this consider that the first cross does not impair the milking properties of the native stock, while it gives a larger animal, and greater aptitude to fatten. For a pure breed of milking stock Holstein or Dutch cattle have the best records of any known breed, but unfortunately they are not yet introduced into this Province."—*John Smith, Ingersoll, 1883.*

"It is yet an open question among dairymen which breed of cattle is best suited for dairying purposes; for butter making alone, the majority seem to prefer the Channel Island Jerseys, Guernseys and Alderneys, all of which have given a very high record of butter to the quantity of milk, some giving as much as a pound of butter to a quart of cream and some even more.

"In the Jerseys, etc., the cream rises quickly, and in great quantity, and churns easily, producing a firm, rich-coloured and fragrant butter, leaving a thin, poor skim milk almost useless for cheese-making, while in Ayrshires the cream rises much more slowly and leaves a thick, rich skim milk, supposed by some to make cheese very little inferior to new milk.

"Some prefer the Hereford, some the Devons, and others again the Dutch or Holsteins as dairy cattle, almost every different breed having its supporters, but whichever breed be chosen, there are some points in a good cow common to all, some of which are hollowness and thinness in the neck, narrowness in the breast and point of the shoulder, lightness in the fore quarters, not showing in any part a disposition to lay on fat; the hide should be thin, and the hair fine, and the udder full and round.

"Another important consideration is her temper, a quiet gentle cow is not only more easily managed but has generally been found to give a larger flow of milk, of better quality, is not so liable to fall off in her milk as one of an opposite disposition."—*Prize Essay, Ingersoll, 1883.*

The second means of cheapening cost of production is BETTER KEEPING of animals; involving *feed, care, shelter, etc.*

KEEPING OF STOCK.

Feeding.

"Take a cow weighing 1,000 pounds, feed her twenty pounds of hay, or its equivalent, daily, and you maintain her in a condition that will just keep her in life. That is the food necessary for her support, and you are no partner in it. You feed her twenty-one pounds, and that extra pound, which she does not need for her support, she gives back to you. Feed her forty pounds of hay, and she will give you back the twenty pounds in the form of milk, and you then become even partners with her.

"Feed her enough to be contented, and you will share richly in her product. It is well, however, to find out how much a cow will eat and digest properly. Some cows are weak and will not digest as much food as others, or to be profitable to keep them."—*Lewis.*

"Next attend to her food; feed her all the good hay she will eat at a given hour, morning and evening. The cow is like a child, she is incapable of deep reasoning, and becomes fretful and impatient if not fed or milked at regular hours. When I say hay, I mean good hay, dried grass, not overripe hay. If fed too much, clean it right out when she stops eating, or use it for bedding."—*Lewis.*

"Towards night, at a regular hour, I feed my cows all they will require and then leave them quietly to themselves, unless it be before bedtime, to give them some more bedding and to clean their stalls, but I don't feed them. The cow needs time to masticate her food, for she is a ruminant animal. Watch her while chewing the cud, with eyes half closed, a picture of contentment, a model of happiness, and ask yourself if it would not be foolish to disturb the operation by feeding her oftener than twice a day? I was led into the practice by accident. A friend of mine who had a large dairy, wintered part of his stock a distance from his house. After breakfast, he would get out a horse and ride over to this distant barn, filled with dry cows, turn them out to water, clean

the stable, put in all the hay they would be able to eat, fasten them back in their stalls and leave them until next day. Going over with him one day, I was surprised to find them, with this treatment, in good condition, and it set me athinking, and I saw the necessity of the cow having plenty of time to chew her cud. You men who feed your cows every time you go into the barn, and so interrupt the process of mastication, will find they will do better if fed only twice a day."—*Lewis.*

"Feed by the clock. Cows, like ourselves, are creatures of habit. I feed twice a day, feed all they will eat, and when they leave off, I clean away, and give no more till next time. When they are done eating they lie down and masticate. If you feed little by little, every time you go into the barn, you disturb the process of mastication, and the cows do not thrive."—*Lewis.*

"In the combination of the necessary elements of food was the success of the feeder vested. Milk represents all that enters into the elements of animal bodies, otherwise you could not raise a calf upon milk." Timothy hay possesses ten per cent. of albumenoids; clover hay possesses eighteen per cent.; oat, barley, and wheat straw, about two per cent. Now, mix two pounds of straw with one pound of clover hay, and you have a mean of ten per cent., equal to timothy hay. A good food, too, is oil cake, strong in nitrogeneous properties, with straw. Two quarts of shorts mixed with twenty pounds of straw, dampened, would be as good food as hay, and less costly.

"A good plan is, just before haying, to take surplus straw, run it through the straw cutter, and mix it with six parts of green food. This thrown into a large ben is, when winter arrives, an excellent food."—*Prof. Stewart at Belleville.*

"Great attention is paid to the digestive powers of each individual, and upon this is based the composition of the various rations. On principle it is always sought to maintain the same proportion between the quantity of moist and dry matters used as food. As hay is scarce in Denmark, straw is often fed twice a day, with one feed of hay.

"When a mixture of crushed oats and barley is fed, it may be composed of equal parts, say five pounds of each. Then there may be added one pound of *rasp kager* (rape seed cake) and two pounds of wheat bran, making eight pounds in all, which quantity may be increased, according to circumstances."—*Dairying in Denmark.*

"The cow must first be sustained, and as this must be done in either case, one can see that the more liberal the surplus the better. It not only stands to reason, but experience proves it. If they do give milk out of proportion to food consumed, it is at the expense of their own bodies, and no kind of food is so expensive as cow flesh, or beef. It is better to *keep* the condition up, than to *get* it up. However, those who practise feeding up in the winter and running down in the summer are a long way ahead of those who starve in the winter, with the idea that their cows will give milk and fatten at the same time in the summer. Such practice is both foolish and cruel. The fact is *food* does everything. It not only supports life, but gives heat and motive power, performing much the same to an animal as coal to an engine, and the great question is how to economize it. As far as the heat is concerned this may be done by keeping the cow warm artificially. If farmers could see their stock burning their food in order to keep up heat they would open their eyes to the necessity of warm stables. In regard to *motion*, food may be saved by causing as little as possible consistent with healthy exercise. All running of cows by boys or dogs, going far to pasture or water, or any undue excitement, or want of comfort, is at the expense of food, and diminished quantity and quality of milk.

"Again, food may be saved by the exercise of judgment in feeding. There are no rigid rules that can be laid down, when and what to feed. One cow will need different treatment from another; their age, condition, and time of calving must be studied. If, as is generally the case, part of the herd is late in calving, and in good condition, straw and chaff may enter largely into their winter rations for a time. But in every case cows so fed should receive a little corn-meal and bran daily. They will eat no less straw for it, and it will do them much more good. The trouble with straw is, not the want of nourishment, but the inability of cows to digest enough of it. As a general rule a variety is the best, and just how to proportion the different articles of food to different animals, according to their condition, must be the study of the dairyman."—*F. Malcolm, Ingersoll, 1883.*

"We cannot but notice daily a great number of cows and other stock, using the whole of the food given them in cold winter months to supply the natural waste of the body and to keep up natural heat, 'without gaining one ounce of weight or producing any other profit,' 'consuming all the feed to pay a life tax *for existence.*'

"It is required that all animals be preserved in health, and this necessitates the use of a certain amount of food without any increase of growth or milk produced, simply that it may exist to perform some useful duty.

"I would therefore press upon the dairy farmer to be particular to choose his dairy cows healthy and adapted to his business, and avoid wasting so much of his valuable food in keeping his cows with a bare existence, but feed them to their full capacity, as it is from the extra feed, over and above the requirements of the body, that the farmer receives as profit. He thereby gets a greater return from each cow, as she will milk larger and give more daily; and in the end, when you have done milking, you have a fine fat cow, worth more money to the butcher than what she cost when fresh milk. By this course he has saved a portion of the life tax on all his cows, sold one mentioned previously for more than she cost, received larger profits annually at less outlay for animal machinery, and tacked up the hole in his purse, which the dairyman cannot do who keeps a great number of poor cows living a good portion of their lives or time paying life tax, and in the end, when done milking, sell for dollars a head less than what they cost, or require a good large sum of money and time to make them saleable to the butcher."—*Jos. Fisher, Ingersoll, 1883.*

"But whatever diversity of opinion prevails concerning the most profitable breeds for milking purposes, there can be no dispute concerning the profits of liberal and judicious *feeding.* Animals must eat to live. To produce milk and beef they must eat more than is barely sufficient to support life, and the quantity sufficient to support life varies according to temperature, exercise, excitement, etc. It requires food to keep up animal heat—hence the economy of having comfortable stabling for stock. If animals are exposed to a low temperature, just so much more food must be consumed to overcome the effects of this intense cold. If the cows have a long way to go for water or pasture, or are hurriedly driven by dogs, exercise and experiment must be compensated for in food, or diminished production results. It is to the amount of food that is given over the amount sufficient to support life, that we must look for our profits; up to that point all is expenditure and no returns. Without generous feeding breed is of little consequence, and profits nowhere. By generous feeding the productive capacity of any herd can be wonderfully increased, and this increased productive capacity also impressed on their progeny. Had the same care in feeding and breeding for milk been as long exercised as in breeding and feeding for beef, we would now be in possession of a breed of settled superiority as milk producers."—*John Smith, Ingersoll, 1883.*

Cured Corn Fodder.—"Over the parts of United States and Canada where cattle are fed in the stables for six months of the year, more or less, because grazing is impracticable owing to long winters, cured corn fodder becomes a very valuable forage when properly treated or prepared for the herd, whether milch cows or store cattle. To throw it out in the yard, or to feed it in the stable unprepared, is wasteful. To use it at the best possible advantage, it should be finely cut and well mixed with shorts or cotton-seed meal, wet with boiling hot water. Prepared in this way—a layer of cut corn fodder and then a layer of shorts or cotton-seed meal, or Indian meal instead, a very excellent feed for cattle is thus made, better than hay that sells for $20 a ton and upwards. Maize meal and its like contain too much of the albuminoid elements, fat, starch, etc."—*American Paper.*

Injury from Feeding Concentrated Food.

"There is another question raised by the experiment of Mr. Scott, and that is, to what extent milch cows are injured by feeding concentrated food? He asserts that he spoiled a cow by feeding meal. Of course cows are liable to be injured by over-feeding; but we are not prepared to admit that a judicious use of meal will injure a cow for milk. The feeding of meal may be, and doubtless is, more expensive than grass cut and prepared as he suggests; and admitting that such hay makes the most milk, it does not prove that

meal fed judiciously will spoil the animal, without it be from over-feeding. Cows doubtless are injured and their lives shortened by excessive feeding of meal and grains, but if hay is poor or cut after half of its nutritive elements have passed away, the waste must be made up in some way in feeding, or the animal runs down, and when turned to pasture, is a long while recuperating."—*Willard.*

"A dairyman should economise all the fodder he raises upon the farm—straw and corn-fodder, as well as hay. He should study the practical quality of each kind of food and learn to mix those of different qualities together. He should learn that grain, as a part of the ration, is cheaper than hay, and that by mingling a little grain—such as oats, wheat-bran, oil-meal, cotton-seed meal and corn-meal—with straw he may make it better and cheaper than hay. When the dairyman shall study this question of foods, he will raise those rich in muscle-forming matter to mix and feed with those composed mostly of carbonaceous or heat-producing matter. Clover has 14 to 20 per cent. of muscle-forming food, whilst straw has only 2 per cent. Timothy hay has about 10 per cent.; and it is easy to see that, if you mix half clover (having 18 per cent.) with half straw (having 2 per cent.) the mixture will average 10 per cent. of muscle-forming matter, or will be equal to timothy hay in this most desirable element. Pass straw through a straw-cutter, and a bushel will weigh five pounds. Now, two pounds of wheat-bran, or middlings, mixed with this straw, will make the seven pounds better than timothy hay; or if 25 pounds of middlings are mixed with 75 pounds of straw, the 100 pounds of mixture will winter cows as well as 100 pounds of good hay. The average cost of the middlings for this 100 pounds of mixture would be 18 cents, whilst the hay will average, over the whole country, $10 per ton, or 50 cents per 100 pounds. It will thus be seen that straw may be saved at considerable profit. It is better to mix corn-meal with the bran—say one-third corn-meal with two thirds—and mix the straw with them for feeding. The dairyman does not seem to appreciate the necessity for variety in the food of his herd. He should raise several kinds of grain, and grind these all together. Corn and oats ground together are better than either alone. Peas and oats grown together should be a more common crop among dairymen. It makes an excellent food to strengthen and recuperate a cow after the milking season. They are both rich in muscle and bone-building elements. When raised as a joint crop, the crop should be harvested when the peas are ready and before they shell. An excellent additional food besides fodder is two quarts of corn-meal mixed with one quart of oil-meal per day to a cow; this, fed upon two bushels of cut straw, will keep a cow in fine order and cost less than hay. It must be understood that warm shelter is absolutely necessary for profitable wintering of cows, upon any diet."—*National Live Stock Journal.*

Feeding Calves.

"When it is intended to supply the natural waste of the herd by raising calves, it is important that the best cows in the prime of life should be selected, and put to the bull so that they will calve about the end of February. This gives a chance to feed milk until the factory starts, which should be new for two or three weeks, and then gradually brought to skim. A little wheat mush is an excellent and cheap food to mix with the milk. Hay and ground oats should be supplied as soon as they will eat them. They should be kept in a warm, dry place, until the pasture is good and the weather warm. They may now be entirely weaned from milk, and their mush fed in warm water until they learn to eat dry chop stuff from a trough, which should be fixed at a convenient height against their pasture fence. Calves fed in this way will not look as well in the fall as if fed milk all summer, but if stabled early, and well fed and cared for through the first winter they do well, and will grow very fast as yearlings. They should be brought to milk when twenty-six months old. There are two reasons for this: one is, there is economy in liberally feeding the growing animal; the other is, it early develops the milking quality, which is more likely to remain with the cow than if brought to milk a year later. If any give evidence that they are unsuited to the dairy they should be put dry early, and turned into beef at three years of age. This course persisted in will result in a valuable dairy herd."—*F. Malcolm, Ingersoll, 1883.*

"A correspondent gives the following as his experience in raising calves: Take the calf from the mother at two or three days old. Teach it to drink milk. Skim milk is

best, if not soured, as it makes bone more rapidly. It should have the natural warmth of the cow's milk when drawn. Give two quarts in the morning, one at noon and two at night the first two weeks. Increase the feed as the calf gets older as your judgment dictates; at ten weeks old he can stand eight quarts at a meal if he can get it, and will grow proportionately. Should he scour, which he will if not fed regularly, or the feed is too hot or two cold, or the milk is sour, or the calf was not healthy from the start, give him a pint of hay tea after every meal until cured. If it is a spring calf keep him in the barn until the middle of September. The hot sun of summer months is detrimental to calves. See that his bed is cleaned every day, and use good clean straw for bedding, but never swamp hay or sawdust. Have a box of wheat bran where he can lap it from the commencement; also fresh water. He will soon learn to use these; also a wisp of coarse hay. Do not feed corn meal the first year, and always feed the milk clean, and after nine weeks you need not heat it, and it is not absolutely necessary to feed it after that age if not convenient, but feed shorts until at least six months old. Veal calves should have all the milk they can take until at least six weeks old. After they make bone and the cutlets lose their fine flavour, it is no longer veal in its true sense. In conclusion, let me say, commence to train calves the first week; give them a name; they will learn it; teach them to lead, and all you wish them to know, and they will not forget it."—*North-western Farmer.*

Spring Feeding.

"When the weather gets warm and the ground solid enough to be poached, I let my cows go to grass, and do not wait for it to grow, for this reason, that by going on pasture when the grass is just beginning the change from hay to grass is made gradually, and the sudden shock of changing all at once from hay to grass is avoided. By my way the grass increases from day to day, with less and less of hay. Nor does it hurt the pasture, provided it is not so soft as to be hurt by their hoofs, for you will find a pasture on which the cows are let out early will carry more of them than one on which the grass is allowed to come up strong. The reason is, that where cows are turned into a pasture where the grass has got a good start, they, for reasons we do not know, will leave portions untouched, and crop others bare, whereas if let into the pasture when the grass was springing they would have eaten it all down equally and continued to do so all season. Having been imprisoned half a year in the stable the cow sighs for the pasture, gets restless; so, I say, open the gate and let her go to grass."—*Lewis.*

Spring and Summer Feeding.

"There is a great difference of opinion among dairymen in reference to the kinds of grain best adapted to milch cows in spring. Dairymen generally suit their own convenience in this matter, without much regard to the opinion or others. If they have raised and have on hand a surplus of corn, or barley, or oats, they are very apt to feed one or the other as best suits their convenience at the time; and if grain is to be purchased, the matter of prices has more of a controlling influence than what is best adapted to the animal economy. So widely do people differ on this question that many prefer to feed in spring nothing but hay, if of good quality, claiming that the cows will be healthier when turned to grass, and that the net profits from the dairy will be greater than where grain is used in spring feeding. In other words, that the value of the grain fed in spring more than balances receipts from the extra quantity of cream and butter produced; and hence grain feeding in spring must be very poor economy."—*Willard.*

Summer Feeding.

"The most natural, and, of course, the healthiest food for milch cows in summer is the green grass of our pastures. When cows are giving an extra quantity of milk, and in consequence are milking down thin and poor, it will be advisable to use concentrated food. The principle to be understood is that milk of good quality and large quantity depends upon food, and that the condition and strength of the animal must at all times be kept up. If allowed to run down and become poor and weak, we are undermining the

constitution of the cow, and by inattention and neglect defeating the ends by which our best interests are to be promoted.

"On the question of feeding cows grain through the summer, the general opinion among dairymen is, that it does not pay so long as the herds have an abundance of good grass. When shorts and bran can be obtained at cheap rates, and feed is beginning to fail, they may doubtless be employed with profit. Mingled with the hay and fed to cows, the milk gives a larger percentage of cream, while the quantity of milk also is increased.

"When cows are first turned to grass in spring, if feed is abundant, they should not be allowed in the pasture but a few hours each day for several days; the change of food should be gradual. Serious troubles have sometimes resulted from inattention to this point, especially when turning cows into luxuriant afterfeed in autumn."—*Willard.*

"As soon as the drouth comes, have a substitute ready, and my experience is that nothing is equal to aftermath. I have fed millet, oats, and peas cut early, and sowed corn, and have become convinced that aftermath is best. A meadow sown to early maturing grasses I cut twice, and feed as needed, night and morning, irrespective of weather. We may yet use ensilage, but I doubt it. Wheat bran, Hungarian grass, oats, cut when the first joint begins to turn yellow, are all good in the time of drouth. I give the extra feed in the barn, rather than let the cows go into the field, the gate of which might be dreadful hard to keep shut afterward."—*Lewis.*

"The first three weeks of this period great help may be had from a few acres of early cut clover, well cured. Then oats and peas grown together on a piece of rich land will yield a large amount of succulent food; they will be relished all the better if simply wilted when fed. Fodder corn will come next. But there is a great difficulty in connection with feeding green crops at this season of the year, and that is *the want of time.* When a number of cows are kept it would need a considerable part of the time of one hand to attend to them, and most farmers have not a hand to spare. Where this is the case, I would recommend what I have practised, the feeding of bran. It requires very little time to attend to it, and the crops that would otherwise have been used for green food may, as a general thing, be looked upon as equal in value to the bran consumed. In the summers of 1880-81 I fed bran from the end of June till the middle of September, giving each cow, morning and evening, about three and a-half pounds immediately after milking. It was fed dry in the stable, and as soon as hay was cut supplemented with the best of early cut clover, if they wished to eat it. Last summer the pasture was unusually good, so that summer feeding was not so great a necessity. However, for about three weeks, at the worst time, green oats and peas were fed by scattering them from the waggon on the dry pasture. They were nearly all eaten, and what was left was in the right place for manure. The result of this feeding was very satisfactory, realizing on an average for the last three years of nearly 6,000 pounds of milk per cow. There was also the manure from the bran, which is an important item. Joseph Harris, of Rochester, says that, in comparison with artificial manures at their usual prices, that manure from a ton of bran is worth $9.60. Others say it is double the value of that from cornmeal. But this is not all. The extra condition of the cows was very marked. Another dairyman declared in the fall of 1880, 'Your cows are worth $10 per head more than they were last year.' Here are three items to be set against the cost of bran —*extra milk, manure* and *condition.* That it paid few will question."—*F. Malcolm, Ingersoll, 1883.*

"Although we have not the moist climate and luxuriant pastures of Old England, we have a wealth of sunshine that that country is a stranger to, and this we can turn to advantage by raising fodder corn to supplement our failing pastures. From July to the end of the growing season corn is a long way ahead of anything else as a soiling crop. It is easily grown, and produces an immense crop of fodder, is eagerly eaten by all kinds of stock, and produces good milk. All things considered, there is no crop that can be grown so cheaply and is so well adapted for tiding over a deficiency of pasturage as corn. It should be sown on rich land, and in drills about thirty inches apart. The rows, if possible, should be north and south, so as to get the full benefit of sunlight. When grown too thickly it is less nutritious, by not maturing sufficiently. If an acre of corn can be grown for every six cows, this will generally suffice to carry the cows through till

roots are available. What is not required for this should be cut before it gets touched with frost, and shocked, as it makes excellent winter fodder. During October roots will be available. For milking stock mangolds are preferable to turnips, as the latter impart a flavour to milk and its products that is not relished by consumers, and depreciates values considerably. The White Globe and Greystone variety are not thus objectionable, but they are less nutritious and are not long keepers. As mangolds will keep till June, they are excellent for milk in May till pasture is again available."—*John Smith, Ingersoll, 1883.*

"Having selected the cow, the next question is the feed. In order to obtain a supply of rich, clean, healthy milk, the cows must be uniformly well fed; in summer, in rich, old pastures, free from weeds, where the grass is produced plentifully, and of a quality relished by them; long, rank grass may produce a flush of milk, yet such milk will not produce so much cream, nor will the butter be so good.

"The pastures should have plenty of shade trees to protect the cows from the scorching sun in summer, and it should also be supplied with plenty of good, clean water from a running stream or good well, as it is a well-known fact that bad water causes more taint in milk than almost anything else.

"There should be a supply of green feed grown to keep up the flow of milk during the dry season, when the pastures are liable to fail, corn will give the largest supply of milk, but oats or tares will give the most butter."—*Prize Essay, Ingersoll, 1883.*

Soiling.

"Soiling milch cows is a system which has at times attracted considerable attention, but has as yet failed to secure a permanent foothold over any large section of this country.

"Soiling consists in the stabling of the cattle throughout the summer, and the cutting and carrying to them of green food. The advantages claimed for it are that a cow may be maintained on a much smaller quantity of land by the soiling process, that fences will not be needed, and that the manure will all be saved. The disadvantage is the amount of labour involved. The practice of partial soiling, however, or of providing a forage crop, such as sowed corn, to be cut and carried to the cattle during the late summer and early fall, when the pastures are so liable to be cut short by drought, is growing in favour, and must certainly be followed by everyone who would make the most of his land with the least outlay.

"For the complete maintenance by the soiling system of ten cows and a pair of horses, it would not be safe to start on less than twenty-five acres of land, to be cropped about as follows: Four acres to be sown in clover and orchard grass during the spring, a year previous to the commencement of the soiling, by seeding at the rate of six quarts of clover seed and one bushel of orchard grass to the acre of land, and four acres to be sown at the same time in timothy and English blue grass (tall fescue), at the rate of four quarts of timothy and a bushel of the fescue to the acre. During the following September, six acres should be sown with rye, at the rate of one and a half bushel per acre; the next spring, two acres should be planted with sugar beets as early in April as possible, and two acres sown with oats at the rate of two and a half bushels per acre. All this ground should be made as rich as possible. The remaining eight acres should be planted with corn for a grain crop, at the proper season, and it will be a profitable investment to have sown these eight acres also in rye, turning under as a green manure such as the cattle have not eaten off.

"As soon in the spring as the ground is dry enough not to be injured by the trampling of the cows, they may be turned upon the rye, first upon the portion intended for corn as a grain crop, and later upon the other portion, where they may be kept by means of a portable fence, and may be allowed to graze whenever the ground is suitable until the clover is ready for cutting, which will be from the fifteenth to the twenty-fifth of May, according to latitude and season; the wet weather being provided for by dry feed, or by cutting on the rye not under pasturage. When the cows are taken off the rye the ground should be immediately ploughed, manured if possible, and the part not devoted to a grain

crop sown with corn at the rate of about a bushel to the acre, in drills twenty-four to thirty inches apart, for a fodder crop.

"The clover will now afford daily cuttings for a month, or until the twenty-fifth of June, from which time until the tenth of July the timothy and fescue should be fed from. From the tenth to the twenty-fifth of July the oats will bear cutting, and from that time forward the sowed corn will furnish the feed, the oat stubble and the first acres of sowed corn stubble being ploughed as early as possible and sown in rye for the next year's feeding, rye being also sown in the standing corn of the grain crop. If this rye be also sown by the middle of August, it may be depastured for two to four weeks during the fall without detriment to its yield during the spring.

"If the season be favourable, each of these crops will yield considerably more than will be consumed during the summer, and the residue will be harvested and added to the corn fodder, beets and grain for winter feeding. By some such system of cropping as this twenty-five acres of good land will be found amply sufficient for the annual maintenance of ten cows and a pair of horses. Some feed may have to be bought during the first winter, but as the fertility of the land is increased by the manure made and by judicious rotation of the different crops, its productive power will be so increased that the number of cattle may be increased by several within a few years."—*Agricultural Paper.*

"Summer soiling in the dairy consists in having an abundance of succulent food for milch cows, supplementary to pasturage during summer and fall, when grass begins to deteriorate and fall off in quantity.

"It has been abundantly proved, from all experience, that cows, to make the best returns, must not be allowed to shrink very much in their yield of milk during August and September; for the milking habit being checked at this season, and the yield diminished to a small quantity, it cannot be brought back again to a full flow during the remainder of the season, though grass may be plentiful and fresh. In ordinary seasons, feed in pastures begins to dry up and becomes brown and woody toward the last of July.

"Among summer soiling plants corn ranks first in importance. It is adapted to the soil and climate over an extensive area. It is easily grown, produces an immense crop of fodder under good cultivation, is eaten with avidity by dairy stock and makes good milk. Everything considered, there is no crop that can be grown so cheaply and is so well adapted to milch cows in helping out deficiency of pasturage as corn. In growing the crop the land should be rich and well manured, and put into good tilth. About the middle of June is the time usually employed for putting in the seed, of which the sweet or sugar varieties are esteemed the best for a soiling crop.

"On fertile soil, with good culture, it yields from twenty-five to thirty-five tons of green fodder per acre. The seed should be sown in drills, the rows being about two and one-half feet apart, so as to admit of a cultivator or horse hoe being run between the rows when required. A favourite way with some is to make double rows, making the drills about six inches apart, and the seed in the drills an inch apart, and leaving a space of two and one-half feet between the double rows for cultivation with horse-hoe and the admission of sun and air. Corn fodder, when grown very thickly, so as to exclude the sun, does not mature sufficiently, and is less nutritious than planted in rows, as described, and in order to get the greatest benefit from the sun's light, the rows should be run north and south. On good, rich land, when properly cultivated, one acre of fodder corn will be sufficient for eight cows as a supplementary feed to pasturage and the bridging over the dry season. A portion of the crop should be put in at the earliest time practicable, while other portions may be sown later, so as to have fresh and succulent food in succession. It is in its best state for feeding when ears have formed on some of the stalks and are in a milky state.

"As fodder corn, when ready to cut, contains a large percentage of moisture, the quantity required for a day's feeding should be cut at least twelve hours in advance of feeding, so as to have time to wilt and get rid of some of its surplus moisture.

"No farmer who desires a good yield of milk should neglect to grow an ample supply of fodder corn, even though he may find it necessary to feed additional rations of bran, etc., during droughts or the falling off of the usual supply of pasturage."—*Rural New Yorker.*

"There is another system of management adopted by some with great success. When lands are expensive and a considerable portion of the land is arable, the rougher or broken lands, and such as are not easily cultivated, are put into permanent pastures and a system of half soiling is adopted.

"The plan of whole soiling, or keeping the cows in the stable and yard, has been strongly advocated by some, and there are many points about it that commend it to favour. But while it seems to have been successfully practised by a few persons, whose lands are located near cities and are of limited extent, and are in consequence valuable, still the system is not generally adopted among the dairymen of this country or Great Britain.

"The profits of feeding cows wholly by soiling instead of pasturing, must depend of course upon the market value of land in different localities. Where land is cheap and a given quantity of food can be furnished cheaper by pasturage than for the labour involved in soiling, it is evident pasturage will be preferred.

"But the system of part soiling, as now adopted by our best dairymen, is for the purpose of keeping up a flow of milk during the hot, dry weather, when grass in pasture depreciates in quantity and value. European writers have stated that there are six distinct advantages to be obtained from the practice of soiling:

"I. It saves land.
"II. It saves fencing.
"III. It economizes food.
"IV. It keeps the cattle in better condition and greater comfort.
"V. It produces more milk.
"VI. It increases immensely the quantity and quality of the manures.

"The second and third of these propositions are so self-evident that I need not discuss them here; but of the other four I may allude briefly to the arguments urged by the advocates of this system. And, first, how does it save land?

"Cattle that are turned to pastures, they say, waste as much and often more food than they consume. This is done in various ways—by treading it down; by dunging; by staling; by blowing upon it; by lying down upon it; and again, when there is a flush of feed, by a portion of the grass not being touched by stock, thereby becoming rank, old and woody, and thus going to waste.

"The late Mr. Quincy of Massachusetts, who was an earnest advocate of the system, and who practised it with great success upon his farm, says he was enabled by soiling to keep twenty cows on the product of seventeen acres of his land, but which under the old system required fifty acres.

"European writers make the difference between the two systems (soiling and pasturing) as one acre to seven. But, taking Mr. Quincy's maximum quantity, which he says was never at any time required to be increased for the full supply of food for the number of cows named, it will be seen that the number of acres needed through the soiling season for fifty cows would be forty-two and a-half acres. This, it will be seen, is quite a saving, as it would have taken, according to his statement, one hundred and twenty-five acres of this land for the same stock at pasture.

"The objection that the constant ploughing of land under the soiling system would soon exhaust it, is answered by the argument that crops that are not permitted to go to seed make no heavy drafts on the soil; besides, by the practice of soiling an abundance of manure is at all times at command, and hence it is concluded that by no system of farming can land be enriched at so little cost.

"Under the fourth proposition, that it keeps the cattle in better condition, it is contended that animals kept under this system are healthier and not so liable to accident.

"The experiences of the English, as well as that of Mr. Quincy, seem to show that stock provided regularly with an abundance of food, with a plentiful supply of pure water, and otherwise properly cared for, are seldom essentially ill; seldom miscarry or meet with those accidents incident to herds that are roaming over pastures, often subjected to hunger and thirst, drinking muddy and impure water, driven and worried by dogs, breaking down and jumping over fences in quest of food, or otherwise gratifying

their propensity for mischief. They are also more protected against noxious weeds that often injure the milk as well as the animal.

"The soiling system does not necessarily confine the animals wholly to the stable. A yard is provided in which rubbing posts are set, and where shade is insured. Into this inclosure they are turned for several hours during the day, and where they can take all the exercise necessary for health.

"Those who have practised soiling milch cows, seem to be unanimous in their statements that more milk is thus produced than by pasturage. The arguments proceed upon the principle that by soiling an abundance of nutritious, palatable food is always at command, whereby the flow of milk may be kept up to the highest point throughout the season. Experience teaches us what high feeding is capable of doing in the production of milk, and other things being equal, the argument cannot be charged as wholly theoretical.

"In the saving of manures there can be no doubt but an immense advantage is gained. Mr. Quincy estimates the value of manures made from soiling to be equal to the whole cost of labour employed to take charge of his stock.

"I have now gone over the chief points in favour of this system. I can only briefly touch upon the kinds of food to be used and the order of their succession. The English speak of lucerne, clover, peas, cabbage, etc., as used for soiling. Mr. Quincy relied chiefly upon but four kinds of green crops for carrying on the system. 1st, grass; 2nd, oats; 3rd, Indian corn; and 4th, cabbages. He used grass for the first month of the soiling season. This was cut from his earliest pieces, patches here and there about his buildings, and the sides of a private road leading through the farm.

"He gives as the result of his experience, that one acre of good clover is sufficient for six head of grown cattle from the twentieth of May to the twentieth of June. Oats are made to be the food for July, one acre being sufficient for every four head of cattle soiled. The oats are sown at the earliest moment possible, and generally afford a good cut by the first of July. But when oats alone are depended upon without the aid of any other crop, he advises that one-half the destined quantity of land should be sown as early as the seed can go into the ground, and the other half a week or more later, that the crop may have some succession.

"Indian corn is relied upon for the month of August; and during the month of September reliance is placed upon the grass from the second crop, from those acres in which soiling was effected in the month of June. The grass of the second crop, he says, will generally enable the farmer to soil to the fifteenth of October if his grass land be in good heart.

"From the fifteenth of October till the time cattle are housed, reliance is placed upon the tops of winter vegetables, such as carrots and turnips, together with cabbages. This food is distributed in racks under cover, or in the barn, about six times each day in due proportion.

"I do not propose in this place to discuss the minutæ—the time of sowing and best manner of raising crops—as my object has been merely to give a general outline of the system. It undoubtedly has great advantages under certain circumstances, and the plans of barns which I have given, are arranged so that it could be in whole or in part adopted." —*Willard.*

"I do not feed corn to my cows during the drouth in summer. I cut the hay in a meadow for them."—*Lewis.*

Part Soiling.—"Dr. Wight has had some experience in part-soiling during several years past, and he says he is satisfied that when the soil is well adapted to the system, as it is on the Mohawk flats, it is far more profitable than the old method of grazing. His practice has been to set apart about twenty-five acres of pasture for fifty cows. Commencing about the middle of May he lets the cows to pasture a few hours each day, still giving them what they will eat of the early cut fine hay, of the previous year's crop, and which has been cured and stored specially for this purpose. Then he soon begins to cut some rye, sown early and thickly the previous autumn on rich soil. The advantage of rye is, that it is fit for feeding earlier than any other soiling food. But he feeds it no longer when he can get early clover, as it is too light a crop to be profitable. Early clover is then fed twice

a day, as long as it remains green and succulent. Next late, and large clover, followed sometimes by oats, sown thickly on rich soil, and cut just before they begin to head. Oats are succeeded by sowed corn, the seed having been drilled in at different times, and this he continues to feed till frost comes, exchanging awhile with the second crop of small clover, which furnishes as much feed as the first crop.

"He generally turns the cows upon such after-feed as he does not wish to cut for a second crop of hay, both for the purpose of saving the feed and to benefit the next year's crop of hay; as a large growth of after-math left on the ground of the Mohawk intervales, injures the succeeding crop very much. By pursuing this course, he says he finds three acres will carry as many cows through the year as four acres treated in the usual way.

"The expense in labour is considerably more, but that is counterbalanced by the increase in manure. Cows fed thus, he affirms, will at least equal if not surpass those kept in the usual way, in both quantity and quality of milk, and the dairyman, by adopting this method, finds his profits enhanced nearly one-fourth.

"Full soiling he has never practised, as he cannot overcome the prejudice of feeling it to be better for the health and comfort of stock to roam freely in the open air a considerable portion of the time."—*Willard.*

"Having briefly referred to the importance of liberal and judicious feeding, how to provide a sufficient supply most economically we will next refer to. We consider the soiling system admirably adapted to localities where land is very valuable, where the raw material, milk, commands say three times the price of its equivalent in butter or cheese, and where a sufficient supply of cheap manure is available. But these conditions are as yet only applicable to the vicinity of our large towns. Taking the price of land and labour into account, pasturing in its season is the most economical, as well as the most natural method of supplying the most valuable food for milking stock, and at the same time maintaining the fertility of the soil."—*John Smith, Ingersoll, 1883.*

"Could the flush of grass be kept up all the season, there would be no necessity for resorting to any other feed, as grass is the natural, the cheapest and the best of all food for producing milk. But as it rarely, in our climate, keeps up its luxuriant growth later than July, the dairyman who neglects to have a supply of other succulent feed to supplement the failing pastures in August and September must be content with very greatly diminished profits."—*John Smith, Ingersoll, 1883.*

Fall Feeding.

"Many dairymen provide no feed beyond hay to animals yielding milk during the winter. They are often exposed to biting storms of rain, and sleet and piercing winds, all of which operate in reducing the tone of health, and in undermining the constitution. Hence we not unfrequently see cows wasting away with consumption, and meeting with little accidents that prove fatal, because the cows have the vigour to resist them. Some cows, it is true, are inclined to give milk the year round, and are difficult to be dried off. Such animals require something more than hay; and an additional feed of ground grain (oat and corn-meal mixed), should be commenced to be given in the fall, or at least as soon as grass begins to depreciate in its nutritive quality. 'Frozen grass and moonshine,' even though furnished in great abundance, are not the kind of food on which deep milkers thrive and are invigorated. Cows, whether in milk or dry, ought not to be allowed to fall off in flesh late in fall, or at the commencement of winter. Thin cows are sensitive to cold, and require more food for their winter keep than they do when commencing the season with a good coat of flesh. It is always less expensive to get stock in condition during the warm weather, or before the winter sets in; and it is therefore very poor economy to allow deep milkers to run down thin late in fall, as it often entails a good deal of careful nursing all the winter through, in order to bring the animals safely over to grass."—*Willard.*

"Now, we have said that one essential point in the wintering of dairy stock is to have the animals in good, thrifty condition, when they go into the stable at the commencement of winter. Deep milkers are apt to milk down thin in fall, and when there is a disposition to lose flesh in this way, it is always well to commence feeding ground grain, oatmeal, bran and ship-stuffs; since it is much easier and less expensive to put on flesh in the fall,

when the weather is comparatively warm, than in winter. If the animals go into the stables in good condition, and are properly dried of their milk, they will continue to gain through the winter, on good hay alone. But if they get a daily ration of roots—either carrots, turnips, or mangolds—with a little straw to pick at from time to time as a change, they will come out in spring in good, healthy, serviceable condition. They must be fed and watered with regularity, and I prefer that the feeding be three times a day—morning, noon and night.

"In Herkimer Co., where we have been engaged in dairying for seventy years, a great many experiments or different methods of management have been tried, but our best dairymen say that when cows are wintered on early cut hay, with an allowance of roots of some kind, and treated in the way I have indicated, the cows almost invariably do well after calving, with no trouble from retention of after-birth or from garget."—*Willard.*

"For fall-feeding fodder, corn is principally relied upon, and as it performs so important a part on the dairy farm a few words about its cultivation will not be out of place. One thing much in its favour is that it can be grown very successfully, and at the same time the land cleared of thistles nearly as well as with a summer fallow. If the object is partly the cleaning of the land, it should be sown in drills not less than forty inches apart. This gives an opportunity to frequently cultivate, and by using a trace chain instead of a whiffletree a horse can be used as long as the corn stands on end. This chain should be attached to the cultivator by the centre, and the ends spread just enough to allow the horse to walk, by inserting in the links a small hardwood stick sharpened at the ends.

"Just how thick to sow in the drill is a question difficult to answer, as it depends very much on the amount of rainfall. If the season is very dry and the corn thick it most likely will not tassell, and in this undeveloped state is very little value as food. I have found that about two bushels per acre, or twelve grains to the foot, in drills forty-two inches apart, is a very good medium, and with good cultivation and a favourable season immense crops in this way can be produced.

"It should be cut very soon after the silk appears, and partly dried before stocking. If the weather is unfavourable it may need turning, which can be quickly done with a rake.

"It probably matters little whether put up in round or long shocks, but in either case it should be bound in sheaves, as it stands better, and all the after handling can be done more quickly. Corn put up in this way and kept on end makes a very valuable fodder for late fall and early winter."—*F. Malcolm, Ingersoll, 1883.*

Winter Feeding.

"To have stock make a good yield of milk during the season, it is important that the animals be wintered well, and not allowed at any time to get poor in flesh, or weak. The cow that comes through the winter weak and debilitated, and reduced in flesh, will require the larger part of the summer to recuperate. She will yield not only a small quantity of milk during the time she is recuperating, but it will be poor in quality, and hence such an animal can render but meagre profits even on the cheapest kind of land: for her care, and the labour of milking, etc., will nearly if not quite eat up in cost the value of her product. The variation in the quality of milk, on account of poor keep, thinness of flesh, and a debilitated condition of the animal, has been very abundantly set forth by the chemists, in their analyses of milk from such animals. In such cases the butter has been found to fall off from five per cent. to less than two per cent., with a considerable reduction also in the casein. The influence of poor keep on the *quality* of milk, is a question not very well understood or appreciated by the majority of farmers."—*Willard.*

"The root crop is another very important one, the sweet turnip being mostly relied upon. The manner of its cultivation is so well known that I need not discuss it. It is an excellent food for cows in winter if kept in a warm stable, but gives a bad flavour to milk. If fed in moderate quantities immediately after milking, the injury will be very slight. But this is not always done, especially in the fall before the factories close, and the result is great injury to the flavour of the cheese. Where roots are grown for fall

and spring feeding, a better practice would be the cultivation of a piece of mangels or carrots, for this purpose."—*F. Malcolm, Ingersoll, 1883.*

"It is also an unprofitable practice to let cows get out of condition during winter, when they are dry, as this will greatly impair their production during the succeeding period of lactation. A good milk cow at the end of the milking season is usually thin in flesh. Instead of being still further reduced on a diet of dry straw, as is a rather too common practice, she should have a liberal allowance of something more nutritious, in order to improve her condition. Every pound of flesh gained now will add a gallon of milk in the milking season."—*John Smith, Ingersoll, 1883.*

"In winter the cows should be kept in clean, warm, well-ventilated stables, and should be fed with an abundance of good clover hay, and roots, carrots, parsnips or mangels while milking, and turnips when dry, they should also have a little ground grain every day; a mixture of cornmeal and wheat bran is about the best for a milking cow."—*Prize Essay, Ingersoll, 1883.*

Ensilage.

"Ensilage does flavour the butter, and its use, I judge, if it has any, would be to take the place of roots, when the cows need something succulent for winter feed. If ensilage costs less than roots, I may give it a small trial to feed when my cows go dry. Cows like it first, but soon get tired of it, and won't live on it alone. Those who write so enthusiastically about ensilage, feed grain enough with it to keep their cattle fat."—*Lewis.*

"Considerable excitement has recently been created by experiments in preserving green fodder in silos, or underground pits, where it is prevented by pressure from the rapid fermentation that would otherwise take place. We are not aware of any in Ontario, except Mr. Edwin Tilson, of Tilsonburg, who has given the silo system a trial. He is deserving of commendation for his enterprise, and we hope the advantages he and others claim for the system may be even approximately correct. In this case the problem of winter dairying would be satisfactorily solved, and a great future lie before us as a dairying country."—*John Smith, Ingersoll, 1883.*

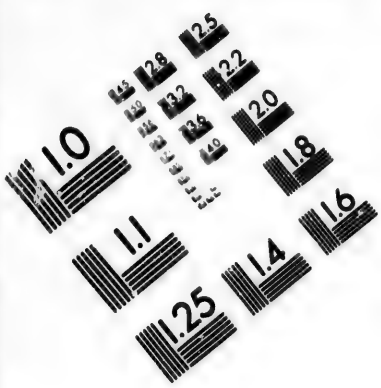
"*Ensilage* is a French word, meaning 'the art of compressing into pits, trenches, or compartments called silos.' It is also applied to the green crops so preserved. *Silo* denotes a 'compartment used for storing green fodder in an air-tight manner.' It may be an excavation in the ground, or a building wholly above the surface.

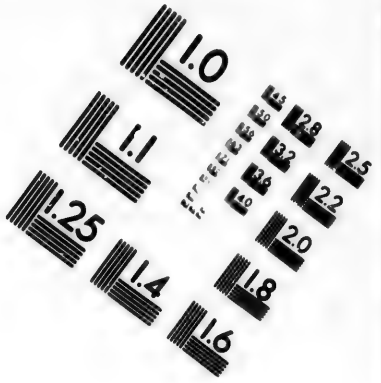
"The object to be secured is the preservation in a green state of the fodder which is cut for the use of cattle during the cold weather. It is well known that by the process of drying, considerable of the nutritive value of the fodder is lost. Grass is known to be superior to hay, and green corn fodder is universally recognized as superior to the dried stalks. That grass not only loses water, but also passes through other changes, is evident from the fact that it exhales agreeable odours while the process of drying is going on. The fact is also sufficiently proved by the difference in the effects of grass and hay when fed to cows which are giving milk. The diminution in the quantity of the milk, and the deterioration of the quality of the butter made therefrom, are abundant evidences that hay is much inferior to grass.

"Not only is the quality of the grass, or other fodder, injured by the process of drying, but there is a great deal of risk of damage by exposure to storms. Then, too, even when it is secured in the best possible order, the dry fodder is comparatively indigestible. Cattle cannot masticate it so easily or so well as they do green food, and are not able to digest it so thoroughly, or assimilate it to so good advantage.

"Ensilage, as a method of preservation, can be applied to all kinds of crops which are used green. In this country it will probably be of the greatest value in its application to fodder—corn and grass. It is with the former crop that the largest number of experiments have thus far been made.

"In order to be fully successful in the preservation of green fodder, all fermentation must be prevented. This must be done by excluding the air. The fodder is to be cut into short lengths, placed in a pit, or in a tight room, and the top closely covered. When the silo is filled, the material must be closely pressed down. In his earlier efforts, M. Goffart followed this course. The tops were covered with earth, and fissures which after-





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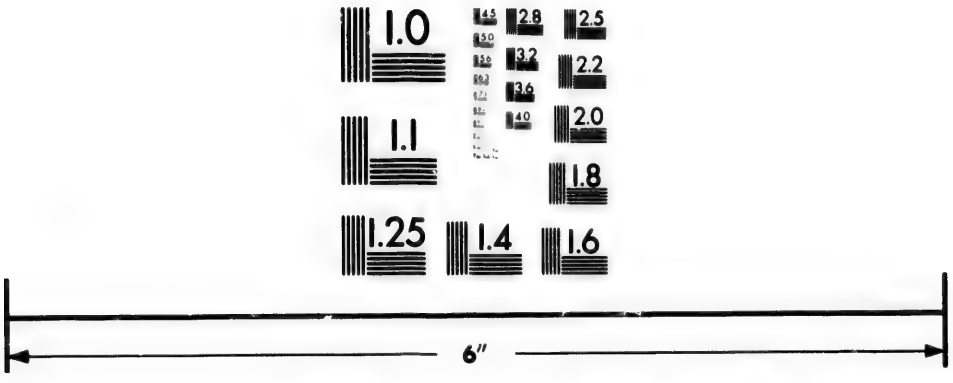

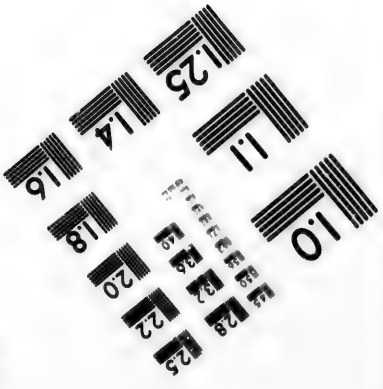

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wards appeared were immediately closed. But there was always found, when the silo was opened, a vacuum between the fodder and the covering. As a result of the vacuum, which was caused by the settling of the fodder, the process of fermentation speedily set in, and the material could be preserved but a short time.

"After many experiments, M. Goffart found that by greatly diminishing the quantity of dry straw which he had mixed with the green corn fodder, or leaving it out, by cutting the material into very short lengths, and by arranging so that it should receive a strong and continuous pressure, perfect success could be invariably secured.

"Pressure must be strong and constant. This, because the material in the silo contains a large quantity of air which, if not expelled, will cause fermentation and decay. When first put in, this material is so elastic that merely treading it down will be of but little value. But in time this elasticity diminishes, the material settles, and, if pressure is not applied, the destructive processes at once begin their action. Therefore there should be a heavily-weighted plank covering for the top of each silo. A little space should be left between the joints of these planks for the escape of air in the silo, and the covering should move so freely that it will follow the material as it settles, and thus maintain a uniform pressure.

"When preserved by this process, no drying is required. Exposure to the action of the sun and air, even for a brief period, will be injurious. As soon as cut, the material should be brought from the field. It should then be run through a feed-cutter, which will make it very fine. Forty-two one-hundreths of an inch is considered the best length. As soon as a sufficient quantity is cut, the material should be packed into the silos, and covered an inch or two in depth with short straw. Then the plank covering should be put on, and heavily weighted in order to protect from the external air, and maintain a strong and constant pressure.

"When the material is to be used, the silo should be opened at one end, or side, and cut down vertically. The quantity removed at a time should be sufficient for the stock for only one day. The material should be taken from the silo from fifteen to twenty hours before it is to be given to the stock. This in order that fermentation, which will make it more palatable, may commence.

"We believe that the discovery of the system of ensilage will have a powerful effect in advancing the interests of the farmers and live-stock owners in the colder sections of the country. As it will enable them to supply their cattle with green fodder during the winter it will prove of great advantage. By freely feeding this material they can keep their young cattle growing rapidly and their cows productive, while a high degree of health will be secured to the whole herd. Then, by enabling the farmer to substitute green corn for grass, the capacity of his land will practically be very much increased. Land which now yields from one to two tons of grass may be made to produce many tons of fodder of a still better quality. Much larger herds can then be kept on a given area of land. As there will be more cattle there will also be a largely increased quantity of manure, with which the grain and clover fields can be made extremely rich and productive. In the various departments of the farm there will be a great gain, and the profits of the business will be correspondingly increased."—*Profitable Farming.*

Injury from Feeding Concentrated Food.

"There is another question raised by the experiment of Mr. Scott, and that is, to what extent milch cows are injured by feeding concentrated food? He asserts that he spoiled a cow by feeding meal. Of course, cows are liable to be injured by over-feeding; but we are not prepared to admit that a judicious use of meal will injure a cow for milk. The feeding of meal may be, and doubtless is, more expensive than grass cut and prepared as he suggests; and admitting that such hay makes the most milk, it does not prove that meal fed judiciously will spoil the animal, without it be from over-feeding. Cows doubtless are injured and their lives shortened by excessive feeding of meal and grains, but if hay is poor or cut after half of its nutritive elements have passed away, the

waste must be made up in some way in feeding, or the animal runs down, and when turned to pasture is a long while recuperating."—*Willard.*

Steaming Food for Stock.

"The discussions which have taken place in regard to the best method of preparing food for stock, and the practice of soiling, steaming food, and cutting fodder have undoubtedly had the effect to lead to a general improvement in the care and feeding of cattle. In questions of this kind, as in most others, the truth is most commonly found in the middle course, and however applicable it may be to special cases it is not universal. Though the opinions of practical farmers differ as to the advantages of steaming food, for example, it is surprising to find that so many dairymen who are raising milk for sale are either steaming their food systematically, or doing what amounts to the same thing essentially, treating it with hot water poured upon it in tubs or feeding-boxes, which are covered and allowed to stand till the materials are completely softened. In this way they induce an enormous flow of milk, the quality of which depends chiefly upon the ingredients which constitute the mass subjected to this treatment. Steaming food will undoubtedly pay in a large milk dairy—that is, steaming or its equivalent—but it will not pay, as a general rule, except where the object is to produce a large quantity with less regard to quality. It has the advantage of enabling the farmer to economize many feeding substances, like cornstalks, coarse hay and straw, since it softens and renders them easily digestible. But though it pays to cut and steam such materials, the same can hardly be said of good English hay. That cooking food improves it is perfectly well known to most careful feeders of stock. One bushel of dry corn, for example, made five pounds ten ounces of pork, while one bushel of boiled meal made sixteen to eighteen pounds, thus showing the great advantage of preparing food for fattening stock so as to put it in perfectly digestible form. System and regularity in feeding are quite as important to success as the condition in which the food is given."—*Massachusetts Ploughman.*

Influence of Insufficient Food on Milk.

"Some remarkable experiments on this subject were conducted by M. Decaisne of Paris, during the siege of 1871, and detailed in a paper before the French Academy, prefacing his paper with observations of Dumas, Payen and Boussingault, in which were shown the fact that a cow gave healthy milk in exact proportion to the surplus of food beyond what was necessary for its own maintenance. If the animal was kept upon food barely sufficient for proper nourishment, the milk produced must be at a loss of animal tissue, with general deterioration of the milk and also of the cow. Milk formed at an expense of the nutrients and tissues of the body has less caseine, butter, sugar and salts, while the albumen will be increased. It follows that the value of milk must depend upon the excess of food beyond what is required by nature to keep up the normal vigour of the body.

"Insufficient food always produces a diminution in the normal quality of the milk, also a variation of its chemical constituents, such as an increase of albumen and diminution of caseine, butter and sugar. The proportion of albumen, in such cases, is generally in inverse ratio to that of caseine. The health of the mother declined with this variation in the quality of milk, depending upon age, hygienic conditions, constitional vigour, etc., until the milk became minimum in quantity and quality. Also, that these effects are seen in four or five days from the time of using an insufficient diet."—*Willard.*

"Different kinds of food have more or less influence on the flavour of milk. Some kinds are much more efficient than others, not only in promoting good flavour in the milk, but in maintaining health and thrift in the animal. For butter-making it is essential that the cows have an abundance of rich and nutritious food. Cows giving milk require more food than when not in milk. A certain amount of food is needed to support the animal, and a surplus above that must be consumed and assimilated to make milk. Food should be abundant and easy of access, because much travelling or exercise in obtaining it checks the milk secretion, the food going to supply the waste of tissue lost in extra labour

rather than for milk. Cows should always be kept in good flesh and condition, because, if from inclement weather or other causes there be a slight interruption in the usual quantity of food, the good-conditioned cow has a store of fat laid up in the system that will bridge over these short periods without feeling the loss so sensibly as the cow thin in flesh, which has no surplus fat to spare."—*Willard.*

Water.

"In regard to water, I start with the broad proposition universally recognized by dairymen of long experience, both in this country and in Europe, that dairying cannot be successfully conducted without an abundance of good water to meet the daily wants of stock. Stagnant water, the water from sloughs, mingled as it often is with a considerable percentage of vegetable matter, even though it be abundant and easy of access, has an unfavourable influence on the flavour of 'dairy goods,' and of itself precludes the dairyman from reaching the highest standard in his product. I have no space now to discuss the physiological side of this question, but I state a fact abundantly proved in practical experience.

"To the dairyman an abundance of pure water, of easy access to stock, will be found important. Many suppose that if there be water located on one part of the farm, the other parts being dry, that will suffice for all practical purposes in supplying the needs of dairy stock. This is a mistake, especially where large herds are to be kept. Cows should at no time be compelled to travel long distances to slake their thirst, since the greater exertion and labour imposed must in proportion affect the quantity as well as the quality of their milk. Instances have repeatedly come under my observation where springs have failed, and cows in consequence subjected to travel over a considerable distance to get water. The milk not only fell off rapidly in quantity, but in several ways depreciated in quality, especially in hot weather, showing a tendency to quick decomposition, and giving an inferior product when worked into cheese. Water should be so conveniently situated in pastures that stock will require no extra or special travel to obtain it, and it should be situated at such points in the field that stock feeding over the ground naturally go toward it, so that when a supply of food has been taken the animals may slake their thirst, lie down, and quietly convert their food into milk.

"For it must be observed that milch stock are averse to any large amount of exercise, and do not ordinarily care to take more than is necessary in supplying themselves with food. Give them plenty of food and an easy access to water, and they quickly fill themselves and spend most of their time at rest. When water is situated in out-of-the-way places on the farm, cows will often go thirsty for a considerable portion of the day rather than make a special journey to obtain it. This has been observed by all practical farmers, and yet it is curious that many who are conversant with the fact neglect to take proper advantage of this peculiarity in the habits of the animal. It is an important object with the dairyman who desires the highest success, to promote as far as may be (without resorting to artificial means) the taking of an abundant quantity of water by his herd. Milk cannot be made without water, and when it is secreted largely, a large amount of water is absolutely required."—*Willard.*

"I have alluded to the importance of providing milch cows with good water, and something more may be said on this point, because it is one of the secrets of success, which the great majority of dairymen to-day do not fully comprehend. The importance of providing an abundance of water for cows in milk cannot be over-estimated. Every practical dairyman must have observed how rapidly cows shrink of their milk in hot, dry weather, when water is scarce and the animals do not get their usual supply. But although in such cases the cause of milk falling off is traced to its true source, many forget to take a hint from such observation in their management of milch stock during the summer and fall. Cows, of course, will live where the daily supply of water is limited, and by yielding a less quantity of milk, they adapt themselves to the circumstances under which they are placed. And if water is not abundant or is situated in out of the way places, where it is not easy of access, the animals soon educate themselves to get along

with a much less quantity than they would were it placed before them in abundance. Up to a certain point, the animal will accommodate herself without complaint to the conditions, and it often happens that because cows show no very marked uneasiness nor falling off in flesh, it is supposed they get all the water which they require, when in point of fact they are taking only a limited supply. Herds thus situated do not yield large returns. The fault is not in the cows, but in their management. Now, milch cows should rather be induced to take all the water they will, and at no time should they be allowed to suffer from thirst. A cow that gives a large quantity of milk, must of necessity require more water, other things being equal, than the cow that gives only a small quantity of milk, for we must remember that of the constituents of milk eighty-seven parts or thereabout are water. To what extent the quantity of milk can be increased and at the same time a good quality be secured, by inducing the animal to take an abundant quantity of liquid, is still a question undetermined, but that milk of good quality can in this manner be increased and without injury to the animal, there is not the slighest doubt. Upon this point we have some interesting experiments by M. Dancel, as communicated to the French Academy of Sciences. He found that by inciting cows to drink large quantities of water, the quantity of milk yielded by them can be increased several quarts per day without materially injuring its quality. The amount of milk obtained, he says, is approximately proportional to the quantity of water drank ~ows which, when stall-fed with dry fodder, gave only from nine to twelve quarts of milk per day, at once produced from twelve to fourteen quarts daily, when their food was moistened by mixing with it from eighteen to twenty-three quarts of water per day. Besides this water taken with the food, the animals were allowed to drink at the same intervals as before, and their thirst was excited by adding to their fodder a small quantity of salt. The milk produced under the water regimen, after having been carefully analyzed and examined as to its chemical and physical properties, was adjudged to be of good quality, and excellent butter was obtained from it."—*Willard.*

"At a regular hour water your cows, and always in the same order. Have pure water, for if it is not you will have impure milk. Besides, we do not know how long a cow can drink impure water without hurting her health. Have a place where she can go up and drink all she wants like a lady, and give her her time. Just let a few cows out at a time to drink. I have found this better. When all are let out together Sally drives Susan and Jane drives Sally, and so a ring is formed and they chase one another round. The cow should be allowed to drink undisturbed, her head being level. I dislike the practice of cutting a hole in river or brook, for when the snow gets tramped round it the cow can only drink by almost standing on her head and drawing up the water on the principle of a suction-pump."—*Lewis.*

"Good, fresh, clean water, and in abundance, is one of the most important requisites for milch cows, and it should be in convenient places, where stock will not be required to travel long distances to slake their thirst. If springs and running streams cannot be had in pastures, a good well, with windmill and pump, makes an efficient substitute, and the waste water may, if necessary, be conducted back into the well, so as to keep up a constant supply of good, fresh water."—*Willard.*

"Cows will drink twice a day and oftener if an opportunity is offered, and it is better than to drink a large amount at once. If cows in milk have water but once, they should be slopped morning and evening to increase the flow of milk."—*Willard.*

Salting Cows.

"Another important matter in the management of dairy stock is to have it properly provided with salt. The best way to salt dairy cows is to have the salt in some place conveniently located for stock, where daily access may be had to it, and the animals allowed to take whatever their appetites crave. It may be placed in boxes arranged in the feed alley of the stables, or in troughs in the shed, or open yard. Where cows have free access to salt, they soon regulate their appetite to the daily use of small quantities of it, taking no more than is required to promote health. Animals require more or less salt, according to the character of their food, and the practice of salting at certain inter-

vals is often injurious, since they are liable to overfeed of it, causing excessive scouring and derangement of health. This is particularly the case when salt is thrown out to stock indiscriminately in the fields at intervals of a week or more. In such cases the master cows not unfrequently gorge themselves, preventing the weaker animals from getting a due supply, and thus one part of the herd is injured by overfeeding, and the other part by not obtaining what is needed. When the animals have access to salt, nature dictates as to its use, and hence the best results, both as to health and yield of milk, follow. Salt is very necessary for milch cows. Without it the milk becomes scanty and imperfect. It is an important element in the blood, and furnishes the soda necessary to hold the cheesy part of the milk in solution. Haidlin found in one thousand pounds of milk, analyzed by him, nearly half a pound of free soda, and over a third of a pound of chloride of sodium. There was also one and three-quarter pounds of chloride of potassium. There are various purposes in the animal economy that require salt, and cows in milk should at all times have free access to it. Perhaps the greatest necessity for its use is in spring, when cows are first turned to pasture. The food then is rather deficient in saline matter, and does not furnish sufficient for a large quantity of milk. As grass becomes more mature the mineral elements are more abundant, and there is less desire on the part of animals for salt. It is on this account and because cows have been dried of their milk, that in winter much less salt is required in the dairy than in summer. From experiments that have been made it has been found that in May and June, when milch cows have been deprived of salt for several days, the milk shrunk from one to two per cent. in quantity, and from two to four per cent. in quality. Later in the season the experiments showed less difference. Thus it will be seen that dairy stock, to produce the best results, should have a daily supply of salt, and that the quantity is much better regulated by the animal than it can be by the stock-keeper who doles it out at intervals." —*Willard.*

"Another little matter I may mention here. I keep salt constantly within easy reach of my cows, so that they may take all they want. I do not believe in mixing salt with their food, for then they are apt to eat more than they need for the sake of the salt. My dishes of salt are left out, entailing some waste, but making sure my cows get all they want. If you do not give salt daily, but, say, once a week, the cows will be so eager for it that they will often take too much. In the salt I mix a tablespoonful of sulphur to every quart of salt. I really do not know that it does any good, but I was led to use it first to ward off bloody murrain, and the fact that there has been less abortion among my cows than my neighbours' may be due to it."—*Lewis.*

Growing Roots for Dairy Stock.

"Every one who keeps stock should make some provision for their winter keep by raising a patch of roots. We have heretofore alluded to the benefit resulting from this kind of food for cattle during the winter and spring. The foddering season in latitude 43° falls but little short of six months. Continued feeding of dry food for so long a period has a tendency more or less to derange health. This is particularly so with milch cows, many of the diseases which occur from time to time being induced by badly regulated diet. There is nothing that improves the health of stock like an occasional feed of carrots, beets, or turnips through the foddering season.

"There may be difference of opinion in reference to the kinds of roots most profitable to grow; but there can be none with regard to the improved condition of stock that have a daily or even semi-weekly allowance of this character of food. For the spring feeding of milch cows roots of some kind should be regarded as indispensable. After years of experience in the management of dairy stock and ample experiment in feeding, in order to get the best results for the season, I have come to the conclusion that the value of roots as a spring feed for milch cows can hardly be over-estimated. Dairy stock that had a daily allowance during the spring months, come upon grass in vigorous health, and are enabled to yield heavy returns of milk throughout the season. If a cow on turning to grass is thin and in feeble health, nearly half the summer is consumed in regaining health and condition; and until this point is attained a maximum yield of milk cannot be

expected. Many dairymen complain in the early part of the season that their stock is doing poorly, though an abundance of pasture is provided, and they cannot see the reason. But if the cause be traced out it will often be found to be in impaired health or some derangement of the system, resulting from the character of the food consumed during winter and spring. Cattle like a change of food, and it is as necessary for their health as for that of the human species.

"When we make use of milk from animals it is of the utmost importance that it be kept free from every objectionable taint. A sickly cow not only yields a diminished profit, but she yields unhealthy milk, and unhealthy in a higher degree than her flesh. If for no other reason than improving the health of dairy stock, root culture should enter into the operations of every dairy farmer. Beets, carrots and mangolds should be sown early, but turnips may be delayed till the latter half of June. The mangold has this advantage over other roots, it keeps late, and is therefore valuable for feeding during the latter part of spring. Sugar beets—the white and yellow—are nutritious, and make a good feed for cattle. Beets require a deep and well pulverized soil. In field culture they grow best where the land has been sub-soiled. In root culture, whether for beets, carrots, or turnips, it pays well to manure heavily with well rotted manure. Fresh manures are objectionable in this respect; they induce a sprawling, imperfect growth of roots, and more especially is this so with carrots, In field culture we should always prefer that the drills be so far apart as to admit of cultivation between the rows with horse-power. It takes more land it is true, but then this is amply compensated by the less amount of labour necessary to raise the crop. When labour is high it pays to use the various improved devices for tilling the soil and cultivating crops which are to be worked by horse power. If the rows are from two to two and one-half feet apart they can be readily worked by the horse-hoe, and the weeds kept down at much less expense than by hand labour. All roots demand thorough culture and freedom from weeds. Clean culture is the main secret in growing a root crop. Large returns cannot be had where the ground is allowed to be overrun with weeds, and it is always better to plant no more than can be well cultivated. Some persons make a mistake in laying out more work than can be accomplished with the usual force on the farm, and so in their effort to get through the whole, they no more than half cultivate the ground, allowing the weeds to get the start; and thus root culture is abandoned because it is managed so that it does not pay. This is all wrong; it is always the safest course to start moderately, and as it were, 'feel one's way' into a business until all its parts are perfectly understood. No one need expect to grow carrots, or beets or turnips, without labour. They may require more attention than the inexperienced at first expected, but they are a good investment, and will pay back for all work well directed and judiciously applied.

"Some prefer the culture of carrots because they make a good feed for horses as well as cows. The crop requires more labour, because the plants are of slow growth at first, and cannot be so readily freed from weeds on this account. It is a good plan to sow radish seed at the time of putting in the crop, as the radish springs up earlier and serves to mark the rows.

"Where turnips are to be planted the ground should be well manured and repeatedly ploughed up to the time of sowing. This will keep down weeds and give a good seed bed. Where the ground is prepared by ridging and the seed sown on the ridges it can be cultivated earlier and with more ease than by flat culture. The quantity per acre and the profits of a root crop will depend on the manner in which it is cultivated and cared for. By special cultivation immense yields have been made. In ordinary or fair culture from six hundred to one thousand bushels per acre on good soil may be obtained. Roots should be more extensively grown. By this means more stock can be kept on the farm, an increased quantity of manures made, and of course better profits realized than where no such culture enters into a part of dairy farm management."—*Willard.*

Root Crops.

"Unfortunately the American average farmer knows very little of the value of root crops as food for both man and beast. Those who have learned to grow them with the greatest economy of land and labour have long since become satisfied of the great profit

in their use, and appreciate the benefit they confer on all animals that consume them. In some parts of the United States, for a quarter of a century, root crops have occupied a very respectable place in farming, and indicate an increasing appreciation of their value. If the keeping and feeding of live stock upon the most economical and successful plan be the object of the farmer, then the importance of root culture is apparent. The mangels are prominent among different kinds of roots grown for stock. There are several varieties, as the norbetan giant, long red, yellow globe, and new kinds recently introduced. The mangel is found to yield more tons per acre, and, when fed to cows, to cause a greater flow of milk than any of the roots commonly grown as field crops. Well prepared, sandy loam is the best land for this crop. The best pulverized and manured lands alone will produce a large, reliable crop. Sow in drills twenty-two inches apart, and work well so as to keep down weeds and grass until about the middle of July, when the plants will protect themselves. October is the timeto harvest the roots. The yield of mangolds in England is marvellous—seventy-five tons per acre is not unfrequent, and in New England and New York over fifty tons per acre have been raised. The carrot crop is also well worth the consideration of farmers, as perhaps no root is better adapted for a portion of the food for horses, mules, cattle, and hogs. It gives best flavour to milk and butter, and greatly promotes the flow of rich, creamy milk during the winter season. Turnips, and particularly rutabagas, stand pre-eminent as stock food; perhaps no other vegetable can be so cheaply produced as the rutabaga turnip, or takes up such little room on the farm. It is sown from the middle to the last of June, after all other crops are planted, and will grow between the rows of corn, and will flourish on lighter soil and with less manure than mangold. Frosts will not damage them, and even if they are not housed until Christmas they will still do for use. The common Dutch or English turnip, also, like the rutabaga, makes excellent food for both man and beast. Stock fed largely on roots will be more healthy, more easily fattened, and more cheaply fed, and produce more and better milk than if fed exclusively on hay and grain. In England and Europe no farmer ever thinks of keeping stock without root-food, and no farmer ranks his root crop of less importance than he does his grain crop. Beets, while good for stock food, have become so very popular as a sorghum or sugar-producing vegetable that throughout Europe it is never fed to stock until the juices are extracted and nothing but the pulp is left. In the United States 'beet sugar' is almost unknown, but the time will come before many years when the great supply of sugar from home consumption will be made from the beet roots that will be grown in all parts of our domain. We cannot too highly recommend our patrons and farmers to experiment more liberally in raising roots for stock food, and by making them one of the rotation crops to add to the richness of their lands by the clean cultivation of the hoed crops. Now is the time to make the necessary preparations for such crops as above alluded to."—*National Grange.*

"Farmers are slow to learn the value of carrots for horses. They are so nutritious that livery stable men feed out large quantities to their horses instead of grain. Four quarts of oats and the same of carrots are considered as good for a horse as eight quarts of oats; and horses that are not worked much will keep in good condition on hay and carrots only. A few small potatoes also are very good for a horse, especially to give a smooth, glossy coat. The farmer who has no carrots, beets, or turnips for his stock when winter approaches has made a serious mistake. In England the farmers grow immense crops of 'mangolds' (beets), to feed out in the winter; and if profitable there, why not here? Probably the most easily raised, most productive, and most profitable root crop in this country is some of the varieties of beets, some of which grow eighteen or twenty-four inches long and yield a thousand bushels to the acre, if the land be highly manured; but the best way to grow them is to grow a crop of potatoes the previous year on the land, with a heavy application of manure, and with no manure the year the beets are grown, and there will be but few weeds, if the land was kept clean the year before."—*Agricultural Paper.*

"I want my heifers to come in at two years old, and I feed them well, yet so as not to lay on fat. If you feed a heifer so as to lay on fat, the secretions take that direction, and they will not afterwards make good milkers. Breeders of short-horns, who aim at beef, keep their heifers fat until they are three years old, and their milk never troubles them afterwards. Get up the bone and muscle in your heifers, but avoid fat."—*Lewis.*

Shelter.

"In riding along the highways of the United States as well as Canada, one sees everywhere evidences of the penny-wise and pound-foolish policy which actuates dairymen in the pursuit of their business, and nowhere is it more apparent than in the stables they erect in which to winter their stock. We believe there are thousands of men on both sides of the St. Lawrence who, every five years, by means of poorly erected, cold, and ill-ventilated stables, lose an amount equal to the additional outlay which would suffice to build comfortable ones. Have they not yet learned that a cow constantly surrounded by an atmosphere below freezing, requires much more food to sustain life than one seldom, if ever, exposed to such a temperature? If they are aware of this fact, why, in the name of common sense, do they not build better?"—*Harris.*

"It is but a few years in the past, when you and I, in the heighth of our ambition for the care of our stock, provided for them an open barn-yard, sheltering them with open sheds, and stabling most of our cows in a board and battened stable, and in severe frosty weather we required an axe as well as a shovel to clean out our stables, and they were seldom put in until the close of the day, and we often tested the experiment between one year and another, whether a cow did better in the stable or open shed; very often, and correctly too, decided in favour of the latter. And for watering facilities we would have a well with pump and log trough convenient to our yard."—*P. Gardiner, Brockville, 1883.*

"A very common and bad practice is the turning of cows out of the stable for hours in cold weather. A good rule to decide when they should be in, is if they would be more comfortable, which they will nearly always be in winter except it is calm and the sun shining. This remark is specially true in reference to *cows in milk*, and still more so, *if lately calved.*"—*F. Malcolm, Ingersoll, 1883.*

"The buildings may be variable, yet adding the same comfort to the animals, but shelter and economy of food should never be carried out at a sacrifice of proper ventilation of buildings.

"From the authority of the leading agricultural chemists of the day, all animals draw into the lungs atmospheric air, use a portion of oxygen, and throw off carbolic acid, which is very dangerous, as no animal can live in it, and should therefore be carried off from the buildings by ventilation. (No doubt many animals have died at sea by breathing carbolic acid thrown off from their lungs, instead of breathing pure air.)"—*Jos. Fisher, Ingersoll, 1883.*

Shades in Pastures.

"There are those who advocate that shades in pastures are detrimental to milch cows; or rather, that shade trees, by affording a comfortable place for cows to rest during hot weather, cause a decrease in their milk, and therefore they are objectionable, by holding out inducements to and fostering habits of laziness on the part of the cows. They reason that cows, to yield a large quantity of milk, will require a proportionate amount of food; that the longer you can keep the cow feeding, the more grass she will store away to be manufactured into milk. In hot weather, they say, cows are not disposed to be industrious, but lounge lazily under shade trees in the middle of the day, wasting valuable time and, what is of more consequence, neglecting to keep the milk-producing machinery in vigorous operation. If the pastures are deprived of shade, they say the cows will find it uncomfortable resting in the hot sun, will prefer to keep more upon their feet, and are therefore induced to spend most of their time in feeding. Some dairymen therefore cut down and destroy every vestige of shade in pastures, and are earnestly recommending this system to the dairy public. I hear of some so eager in carrying out this principle that pains are taken to go out among the herd from time to time during the day, starting the animals up from their resting places, and thus urging them to the consumption of more food.

"I do not approve of this system, nor do I believe that it has any advantages on the score of economy. It certainly cannot commend itself for its humanity, since the system is a species of cruelty and a disregard for the comfort of creatures which, though dumb and devoid of reason, have the more claim to our kind care and protection.

"It is undoubtedly true that the quantity of milk can be increased under a forcing system of feeding if certain circumstances and conditions are observed. And, first among these conditions is quietness and freedom from anything like labour or extra exertion on the part of the cow. A certain amount of exercise may be needed for health, but all exercise produces a waste of the animal structure which must be repaired by food. The first office of food is to support respiration and repair the natural waste of the body, and if the waste is excessive, by reason of excessive labour, the food will go first to supply this waste and after that for the production of milk. Hence those who study to get large results from milch cows are careful to keep their animals as quiet as possible, avoiding excessive travel or labour, taking care that there be no disturbing causes for excitement, such as fear, anxiety, or solicitude, for these waste food, and check the secretion of milk to a much larger extent than most people imagine. The principle is true whether acknowledged or not, that the more comfortable we make our milk stock the better will be the results. If during the heat of the day cattle seek shade and lie down to rest, their quietness, comfort and enjoyment will add more to the milk pail than food taken in discomfort and excessive exercise. We are presuming, of course, that the animals are placed in pastures that afford an abundance of food, and pastures should never be overstocked. In good pastures it is not necessary that cows should be constantly feeding, for we can see from the peculiar structure of their stomachs, that nature intended a considerable portion of time to be spent at rest, that the process of rumination and digestion be perfected. The first stomach seems to be simply a receptacle for storing up a quantity of food to be used and enjoyed at leisure. The food as it goes into the first stomach is very imperfectly masticated. After having filled this receptacle the animal rests from her labours and is now prepared to enjoy her food, which is thrown back in small quantities into the mouth, where it is chewed, and then goes into the third and fourth stomachs to be properly assimilated and digested. Hence rest is required; and to deprive the animal of a comfortable resting-place or to drive her out in the hot sun while in the act of rumination or masticating her food food is not only cruel but a piece of intolerable stupidity.

"The only real argument against shade trees in pastures is, that the animals collect there and deposit manure where it is not needed. The proper way to avoid this is to erect temporary sheds, and they can be removed from time to time to different parts of the field and thus be made of double service—affording comfort to cattle and manuring the land. I have seen this plan adopted with the best results; the temporary shades being placed on barren knolls and the poorest parts of the pastures, and these places were thus brought into a high state of fertility. I believe in shade trees and shades in pastures, and am convinced from observation and experience that the herds do better with them than without them. It is an inhuman practice to compel cattle to bear the intense rays of the sun during our hot summers. They need protection at such seasons, and if man finds shade at times not only grateful but necessary, I cannot see why the same rule may not apply in some degree to our domestic animals. It is true they may not die from exposure to the sun's rays, but if the hot, panting beasts could speak we should learn that their health was not promoted by this exposure."—*Willard.*

Barn.

"Build with or without a basement. The cows stand in two rows opposite each other, with their heads facing the outside of the building, and the space in the centre between the cows and the drop is wide enough for a drive way for hauling out the manures. The cows enter at the central door, and take their places on either side. Absorbents may be used for taking up the liquid manures, and every day, when the stables are to be cleaned, it is piled upon a sled or waggon and taken directly to a field where it is to be used."—*Willard.*

"The importance of keeping stock well housed from storms during inclement weather is often under-estimated by dairy farmers. Much more food is required for stock exposed to cold, bleak winds and storms of sleet and snow, than when properly sheltered. A certain amount of food is needed to keep up animal heat, and it is much cheaper to supply this warmth in properly constructed stables than to use extra fuel in the shape of hay and grain, to keep up heat in the open yard. It has been estimated that an animal wintered

in the open yard, without any other shelter than that afforded by fences and the sides of buildings, will consume a third more food than if properly housed. And even with the additional food, the animal does not come out so well in spring as the sheltered animal on less food. The principle is abundantly established, and ought to be recognized by every one who has had the care of stock; and yet, strange as it may seem, a large proportion of the herds are left shivering in the cold from morning till night, under the impression it would seem, that the stable can only be used economically during night, or as a place in which to give food. Some insist that this exposure is promotive of health, that it imparts vigour and tone to the system, and that attention in housing from cold and storms during the day is a species of pampering, highly injurious to the constitution and well-being of the animal. Unfortunately for those who hold these opinions, the record of losses, of accidents, of diseases incident to milch stock, are against the theory, and in favour of those who are careful to shelter their stock from undue exposure.

"Sun and air, together with freedom from restraint, is without doubt conducive to health, but the conditions must be favourable or such as the stock enjoy. An animal may be trained to endure cold, exposure and fatigue, and under certain conditions health may be maintained. But you cannot impose, at the same time, the duties of maternity and the yielding of large quantities of milk, because the waste of the system from these sources is so great as to leave only a small amount of vitality to be employed in another direction. This is particularly the case with milch cows, which, under a system of domestication and breeding, have been educated into a 'milky habit.' Left to themselves under the most favourable circumstances, in warm weather, they like but little exercise compared with other classes of animals; and when required to exercise much, always fall off in milk. Warmth, comfort and quietness are particularly essential to these animals, and any system of management opposed to these conditions, must in a measure, fail to be profitable to the dairyman.

"Cows that are in milk, or that have been milked late, are peculiarly sensitive to cold, and they are frequently injured by being exposed to storms. By getting wet, and becoming chilled, pulmonary complaints and other diseases are induced, and thus the farmer has a sick animal on his hands which is a source of trouble and anxiety, and not unfrequently a total loss. Many of the troubles that come upon cows at the period of calving, may be traced directly to exposure during the winter; and therefore on this account alone will it pay the farmer to shelter his stock on the approach of storms, either of wind, or snow, or rain. During those days in winter that are sunny and warm, there may be no objection to allowing stock to run at large in the yard a greater portion of the day; but in extreme cold weather three-quarters of an hour in the morning and the same length of time in the afternoon, to slake their thirst at the trough, will give them all the exercise needed. The remaining portion of the time they will be better in a warm, well-ventilated stable, where they can quietly ruminate, without fear of being hooked and driven about by master cows.

"Any one who may have closely observed the habits of milch cows kept out in the yard during extreme cold weather, it would seem, could not well come to a different conclusion. The animals often stand about the buildings, pinched up and shivering, the cold exciting to bad temper which they vent upon the underlings, severely punishing them without cause, and many times to the serious loss of the owner. At such times open the door of your stable, and give them choice of entrance, or to remain without; and if they do not seek warm quarters they differ from any of the herds with which I am acquainted.

"The losses from neglect of, and inattention to stock during winter, are so large, that the subject cannot be too urgently pressed upon the attention of dairymen. If farmers will only take a common-sense view of the question, and seriously count the cost of the neglect to which I have referred, I am convinced they will agree with me, that an important saving may be made by the proper sheltering of stock during the rigours of winter."—*Willard.*

"But this is not all; the cold storms and frosty nights are injurious unless the animals are sheltered. Cows in milk, as I have remarked, are susceptible to cold, and if not protected from the inclement weather fall off rapidly in flesh and milk; even in summer a cold rain storm lessens the quantity of milk, as every dairyman must have observed; but towards the approach of winter, after yielding milk for several months,

the general tone of the system is reduced, and the animal is unable to withstand sudden changes without being injuriously affected. Stock that is reduced in flesh at the commencement of winter, will require at least a quarter more food to bring it through to grass than it would did it start in high condition. This fact is lost sight of by many who suffer their cattle to run down in the fall, milking them late, and allowing them to be exposed to all kinds of weather. In cold, stormy nights during the fall cows will do better in the stable, even with no feed, than to be left out exposed to the inclemencies of the weather. What little food they pick up at such times is not of much account; they will seek out some spot that affords a partial protection from the storm and cold, huddle together, and stand there shivering and discontented till morning. It is at such times that more or less injury is done to the underlings of the herd from being hooked and driven about by master cows. Perhaps at no season of the year does stock require more care and attention than late in the fall, and at no season is it so generally neglected. Many never think of housing an animal at this season so long as the ground remains uncovered with snow, and many fancy they are saving fodder by witholding food so long as there are patches here and there of frozen aftermath, that are not eaten down. Such persons are often found complaining that their hay rapidly wastes away after feeding has commenced, and is wanting in nutrition; that their stock comes out thin in spring, and the yield of milk during the summer is less than it should be. They have no definite idea where the trouble lies; it is either in the hay or in the season, or in the cows, and they mourn over their bad luck, when in fact the real cause of all the trouble arose from neglect and want of care and attention in the fall treatment of stock.

"Cows that are expected to yield largely must have careful treatment and liberal feed—they must be protected from the inclement weather in roomy, well-ventilated stables. The importance of comfortable, well-lighted and well-ventilated stables for milch cows is imperfectly understood, although much has been written on the subject. It should be remembered that a large share of the food eaten is used in furnishing warmth to the animal, and if we can supply warmth by artificial means, it will be equivalent to a certain percentage of food. Good shelter, therefore, serves in part for food. It has been well remarked that 'beside the actual loss of food from the increased amount required under exposure to cold, there is a further loss in milk from the *feeling of discomfort*. The secretions are always disturbed by influences that cause pain or uneasiness, and every shiver of a half-frozen cow will make itself visible in the milk pail.'"—*Willard.*

Warm Stables.

"Stables should be kept at sixty degrees, whereby a large amount of food would be saved, as the animal machinery *requires two-thirds of the food to keep it running;* therefore it would be unwise to withhold the other third, in which alone the profit lay. If by keeping warm stables twenty degrees of heat could be saved, the saving would in two years pay the cost of building the right kind of a stable. Light is necessary as well as warmth, and the element of light has the virtue of being cheap."—*Prof. Stewart at Belleville.*

Ventilation.

"It is all right to economize room and keep the inmates warm, if economy is not carried too far. If too many animals are crowded into ill-ventilated apartments the air becomes vitiated and unfit for respiration, because it is breathed over and over again after it has passed through the lungs and been robbed of its vital power. Food once taken into the stomach and passed through the digestive organs is repugnant to all animals, and if forced into the stomach will cause disease and death. Stables may not be tight enough to cause immediate death, and yet may weaken the vital forces of the inmates, and thus predispose them to disease.

"Proper ventilation is indispensable to health of cows both summer and winter, and to cleanliness in milking. If stables are without ample openings over the cows' heads, the pressure of air from without drives the noxious odours from their voidings, and the venomous exhalations, perhaps from old, stale urine under loose, squashy floors, forward to their heads, where they are compelled to inhale them. Such stables are unfit to milk

in, because the milk while being milked will imbibe those odours and become unfit for good cheese or butter. From my observation in searching for causes of the ailments that cows are liable to, I have come to the conclusion that more disease is generated by venomous atmosphere in damp, ill-ventilated stables than by all other causes."—*Willard.*

"It is becoming a universal custom to milk through the season in wintering stables that are constructed to economize room and keep the inmates warm. That is all right in economy if not carried too far. If too many are crowded into illy-ventilated apartments the air becomes vitiated and unfit for respiration, because it is breathed over and over again after it has passed through the lungs and been robbed of its vital power. Food once taken into the stomach and passed through the digestive organs is repugnant to all animals, and if forced into the stomach will cause disease and death. It is a fact not to be ignored that animals and insects whose life is sustained by inhaling the common atmosphere, must have a change of air, or death ensues. If stables are not tight enough to cause immediate death, they may weaken the vital forces of the inmates and thus predispose them to disease."—*Willard.*

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"Openings in the sides of stables are useful in warm, still weather, and to dry and cleanse them, but should not be relied on for breathing air, for they should be closed in severe weather to prevent currents of air striking the inmates, which should always be avoided. An opening forward and over their heads large enough to fodder through the whole length of the stable is little room enough for circulation of breathing air, and would not draw through in currents unless the siding is open below and too airy above."—*Willard.*

Diseased Milk caused by Filthy Stables and Rotten Vegetables.

"Referring to the almost universal use of milk as a diet, and the many cases reported during the last year, which give strong evidence that milk is an agent of far greater danger and more widely diffused as a source of disease than we are aware of, Dr. Crothers describes a severe case of diarrhœa occurring in a healthy family and living in good hygienic surroundings. Called to prescribe for the sufferers, he found that the family had never suffered from this disease before, and it seemed more violent among the younger members than in those grown up. A careful inquiry into the habits of this family indicated nothing unusual, except the free use of milk as an article of food. Sunday, milk was made a prominent dish at dinner, and it was noticed that the days following the disease was increased unless checked by medicines. The milk came from one cow kept in the neighbourhood. Suspecting the milk was not all right, Dr. C. found on visiting the stable that the cow was a small, ill-conditioned animal, standing in a close, filthy stable, ill-ventilated and containing hardly room enough to turn about. The food of this cow was garbage from the street, consisting of vegetables in all degrees of decomposition, cooked and raw, alternated with brewers' grains once per day. Water was given in the food, but occasionally, depending on chance, a pail was brought in. The stable was cleaned once or twice a week, and the doors were closed to keep in some hens. The walls of the building were brick, and the ventilation or renewal of the air must come from the open seams in the door and window. In this place for over three months this cow had been confined, her body was filthy, and her hair stood up in all directions. That the milk was

impure and the cause of the diarrhœa was proven by the complete disappearance of the disease when the family stopped using the milk."—*Willard.*

Care.

"We have observed many others in which it appears to us equally clear that they are not always their own best friends. We have seen them neglecting, year after year, to provide their dairy with pure water. We have known them to own a ferocious dog and keep in their employ a brutal hired man, the former to chase and worry the cows in driving to and from the pasture, and the latter to beat them with a milking-stool and kick them with his heavy boots upon the smallest provocation. Being a practical cheese-maker myself, and having been compelled day after day, to grapple with the baneful results of these mischievous practices, I have felt many times like visiting in person the patrons of factories guilty of them, and making each a present of a pump, a gun with which to shoot the dog, and to advise the hired man to betake himself to some employment wherein his superfluous strength could be laid out to better advantage; and I have often felt like making it a part of my mission to these men to write in large letters in conspicuous places upon their premises, where they will be compelled to read them every day, these words:—'Bad water taints milk, makes floating curds, injures the flavour and lessens the quantity of cheese; and to worry the cows by fast driving or inhuman treatment fevers the milk in the udder and produces the same result as bad water.'"—*Harris.*

"Never strike a cow. I can tell by going with a farmer into his barnyard what manner of man he is. If the cattle dodge at every motion he makes, I distrust he is not as kind to them as he ought to be, and it is worse if he keeps in addition a savage dog. Of all occupations that of keeping a herd of cows is least suited to a brutal man; he had better sell out and set up as the fighting man of the neighbourhood. I should like to see the man who, when the cow kicks the milk-can over, will not raise his voice or strike her, but, reseating himself, praise her and finish milking. That kindness begets kindness is a law of Nature, and is stronger than bars of iron or steel. Practise it, and you will find that kindness on your part begets kindness in others, and confidence begets confidence. On the other hand, it is just as true that brutality begets brutality, and when I see a man abuse a dumb beast, I feel like telling him he has no more brains than a calf and that he stands in his own light."—*Lewis.*

"It is a very common opinion that cattle well fed will not have lice, but this is a mistake. Lice have no objection to a fat animal, further than to kill it if possible.

"The best cure is *prevention.* Keep a watchful eye from the time cattle go into the stable in the fall, till they come out in the spring, and check the very beginnings with some one or other of the many antidotes in common use. If a cow is bad before the trouble is noticed, it is better to take time. I have known the cow killed by over treatment.

"And now I will conclude with the remark that one of the best helps to successful dairy farming is a little *enthusiasm,* and a determination to have things right. System and order should rule, and happiness and prosperity reign."—*F. Malcolm, Ingersoll, 1883.*

Carding Cows.

"The practice of carding cows is of great importance in promoting health, and increasing the profits of the dairy. It not only improves the health of stock, but leads to habits of neatness and cleanliness about the stables, that have an important influence in securing good, clean milk during the spring months. I would furnish cattle with good scratching posts in the yard, and place a pole firmly on posts with one end higher than the other, to accommodate animals of different sizes, that they may pass under and scratch themselves as desired. When these are erected they will soon be found polished from frequent use.

"Balls of hair are sometimes found in the first stomach, from one inch to four inches in diameter. In the spring cattle curry each other, to allay itching, by licking, and in so doing they cannot get the hairs of their tongues, and are forced to swallow them, when they naturally take the shape of a ball. The animal tries to expel it, but the structure of the tongue prevents, when it is swallowed again, and is kept going to and fro up and down many times. Of course such a foreign substance will often produce disease which

is likely to have many names and for which medicines totally inefficacious are prescribed. It is obvious that, at the season named, it is very important in the treatment of cattle to curry them with the curry comb, to prevent the formation of these hair-balls."—*Willard.*

"Give your cows a gentle carding or currying, especially when shedding their hair. No hour can be better devoted than thus brushing or carding your cows, for you will find they will give more milk, need less food, and be more contented and happy. Cleanliness is essential. I perhaps am barbarous in doing so, but I stanchion my cows, and do so because I find I can so keep them cleaner. There are exceptions, but as a rule my cows keep their stalls as clean as my horses."—*Lewis.*

Exercise of Stock.

"In the winter management of dairy stock it has been urged by some the animals winter best when kept confined to the stable most of the time. Some dairymen scarcely allow the cows to leave the stable during the whole winter. Each cow has a water box before her which is supplied with fresh running water as desired. I have examined herds and taken the testimony of the advocates of this system, and although cows kept in a well-lighted, well-ventilated and cleanly stable, daily curried and bedded with straw appear healthy, still I cannot approve of the system. Such cows may for the time give more milk and lay on more flesh, but at the expense of health and vitality. Health and physical development are indispensable. Locomotion is not only natural but necessary. There is not a respectable medical authority in the country that dare recommend the dispensing with daily exercise in the air for man and beast where health and physical development are sought after. Weakness and incapacity are induced by confinement. We must not sacrifice indispensable ends to temporary profit and convenience. Temporary profit is often the wanton violation of physiological law. Provide warm sheds, and well-ventilated stables, with bedding; feed well and groom well, but allow stock an opportunity for free exercise, at least an hour or two each day, whenever the weather permits."—*Willard.*

Drying Cows of their Milk.

"It would be impossible, in the scope of the present volume, to discuss all the essential points of management for dairy stock. I can allude only to some of the leading requisites for success. I commence first with drying cows of their milk at the end of the milking season. There is great difference of opinion among farmers as to the time that a cow should go dry. Some contend that no injury follows from milking cows so long as they will yield milk, or up to within a week or two of the time at which they are to calve; while others insist that at least from two to three months should be given a cow to go dry. The latter is doubtless the more sensible and judicious course to be adopted. A cow that is to 'come in' during the early part of March, should be allowed to go dry in December. She will then have time to recuperate and repair that waste which has been going on in the production of milk, and in building up the structure of the young which she carries.

"It is a great drain on the system to continue the milking of a cow in winter, and up to near the time of giving birth to her calf; and it is to be doubted whether an animal treated in this way will yield any more, in as much profit, as she would were the other course adopted. For it is not altogether the quantity of milk that is to be looked after, but its quality must also be taken into account. Cows that are overtaxed and weak, yield milk of poorer quality than when in vigorous health. And as to the question of health, endurance and long life, all experience must show that the animals wear out sooner, are more liable to disease and mishaps, under the 'excessive milking system,' than when allowed a reasonable time for rest."—*Willard.*

"In drying cows of their milk, attention should be given that all the milk be drawn from the udder at any one milking. Some are in the habit of only partially drawing the milk from time to time, when drying off cows. It is not a good practice, as the milk left in the udder becomes thick and putrid, causing irritation and inflammation, and not unfrequently results in the loss of a teat, or a portion of the bag, the next season. When cows are being dried off, they should be examined every few days, and their udders completely emptied of all accumulated milk; and with cows supposed to be dry, their teats

should be tried at least once a week, all winter, to see if there be any accumulation of milk. I have had serious losses from trusting to hired help in this matter, and taking for granted that it had been properly attended to. There is no safety unless the work is done under your own eye, or an examination made with your own hand. And it may be remarked that in the management of dairy stock, nothing pays better than a frequent oversight of the creatures by the master's eye. Hands, however trusty, sometimes get careless and indifferent in their care of stock, which can only be corrected by constant oversight on the part of the proprietor."—*Willard.*

Before Calving.

"As spring approaches, and you see a cow is coming in, put her in a pen where she can hurt neither herself nor anything else, and give her some care until the calf is all right. When I see the presentation is all right, I leave her alone, for it is rare that any aid is needed in parturition. When the calf is dropped I give the cow a pail of cold water, and if she is still thirsting another in half-an-hour, and, should the fever continue, another soon after. If the cow is in a very cold stable on a night like this, however, I would not give her cold water. My stable is warm and comfortable. The cow at calving is often excited and feverish, and she wants water, Nature's means of allaying fever. For at least a week after calving I make no change in the food. Indeed, if I see that she has a ravenous appetite, yet fails to digest all she eats, I decrease rather than add to her allowance. I give her, however, all the water she wants twice a day. If given oftener, she is apt to drink too much.

"On an average, a cow should have two months' rest before coming in, yet some, if large and of strong constitution, milk up to the day of calving. When I made cheese at home I reared some good calves on whey—not factory whey. I mixed with the whey wheat bran or oil meal."

Pests.

"When you have got your cow comfortable, there is a little pest which grows and multiplies with the warmth. The more comfortable a cow is, the more apt lice are to gather. There are many remedies, but none are of any effect unless applied. There are men who know how to get rid of the pest, and write out recipes to be printed in the agricultural papers, yet do not apply it themselves. It is desirable to select a remedy that will not mat the hair, and I have found that a thorough washing with carbolic soap is sufficient. It cleans the skin and is most unpalatable to the lice. Ask for a cake of strong carbolic soap. I at one time figured out the progeny of a pair of healthy lice, and found in three months their name was legion. They hatch every seven days, and when seven days old begin to lay nits. It costs more to winter lousy stock, and in addition to the waste of food the loss from the discomfort of the cow is considerable."—*Lewis.*

CULTIVATION OF LAND.

A third means of cheapening cost of production may be said to be better cultivation. This opens up a large and important subject of itself, and cannot be fully treated in this connection. It involves, mainly, better *fertilizing, through working of the soil*, and better *seeding*.

"Whether a farmer select his farm or inherit it, what he first needs know is what his land is best adapted to, whether to grain-growing or grazing, fruit or vegetable culture, wool, or dairy husbandry. The nearness or remoteness of the market, or market-place, will have much to do with the solving of this problem. But having decided this point in favour of any one of these industries, or of some other not named, the next thing is to consider the method of cultivation, having reference to the tillage and manuring of the soil, and the preparing of the seed-bed. This involves many important points of inquiry, such as ploughing, as to when, whether in fall or spring, or summer fallowing, deep or shallow, whether a reversible or an irreversible plough shall be used; also, in respect to the harrow used to promote the fining of the soil for a seed-bed, whether it shall be the sharp-toothed A harrow, or the Randall disc harrow. These are all funda-

mental points in good husbandry, and are to be studied as parts of the Art of Agriculture, commonly, but inaccurately apprehended, and from which erroneous notions arise singular misunderstandings and misapprehensions. As an illustration, the subjects of deep ploughing and shallow ploughing provoke many warm discussions among 'practical men,' so called, the one side arguing earnestly against deep ploughing, and the other with equal zeal in favour of it. Being invited to address an agricultural meeting in one of the New England States a few years since, the first question put to me by one of the officers on arriving upon the Fair Ground was, 'Should this ground be ploughed deep or shallow?" My reply was, 'I cannot answer your question intelligibly without a spade or shovel to learn the character and depth of the soil.' One of the best farmers of Massachusetts, an intimate friend, residing in the valley of the Connecticut River, in the town of Deerfield, was an earnest advocate of deep ploughing.

"The reason for this is great and conclusive, as will be noted. He came into possession of a farm located on the right bank of the River Connecticut, that had been thoroughly exhausted by the American system of farming, that is to say, the continuous croppings with little or no manuring. Shallow ploughing had been practised for generations. My friend at once began deep ploughing and thorough tillage, and the result was that on the old, impoverished, run-out farm he harvested most beautiful crops of corn, and the smaller grains, which he attributed to deep ploughing, and he was undoubtedly right. But when he recommended his neighbour, in the town of Hadley, who owned a farm on the next grade of land back from the alluvial of the river, and was of a shallow gravelly formation, to plough deep, he erred, as was demonstrated; for, the advocate of deep ploughing persuaded his neighbour to try a narrow strip of land through the field he was ploughing as an experiment; and the latter to gratify the former, but against his own judgment, ploughed the land as directed, and the result was a lean, poverty-stricken growth of the crop thereon, which forcibly demonstrated the error taught in respect to deep ploughing irrespective of conditions. The interval of the river and the land back from it are entirely unlike; the former is deep, and deep ploughing turned up a fresh soil rich in the elements of plant food, whereas the latter was thin, and deep ploughing covered what loam there was so deep with the substratum of gravel beneath the shallow seed bed, that the plants were nearly deprived of food essential to their growth. These two examples serve to illustrate the subject under consideration. Before leaving this subject, lest some should misapprehend me in what I have said, it should be added that I am no indiscriminate advocate of shallow ploughing, one of the most common defects among farmers. A farmer owning a farm of a tenacious clay soil, should deepen the furrow a little every year, for a series of years, and thus gradually increase the depth of the seed-bed. The sub-soil plough may be used to advantage in some sub-soil foundations as practised by some farmers. On other farms it is not advisable as with respect to deep and shallow ploughing."—*Prof. Wetherell, Brockville, 1883.*

"To make this a successful branch of our agriculture among those who wish to follow it up, whose farms have been robbed of their natural adaptability through continued wheat-growing and general over-cropping, must embrace and assume a particular method. The method I would suggest would be no great radical change among our farmers, but one which could be easily overcome, incur no loss, and peculiarly adapted to the times in which we live, viz: I would propose that the farmers in this country, especially the dairy farmers, take a broadside view of their farm, consider its various kinds of soil, and what nature has made them adapted for. They will find their flats, slopes, and a good portion of their plane land of nearly every farm in some measure adapted to growing grass. Break away from the custom of making all their farms into so many ten or twenty acre fields, and now in these times when fences are only fences, and easy to change, year after year, as necessity requires, change some of their fences in the best contrived way, and set apart these slopes, flats and plane lands to the extent of one-fourth or one-fifth of their whole farm, as the case may require. Make it rich with matter containing soluble ingredients, suitable for encouraging plant growth, mixed with natural fertility of land according to the best system of agriculture. Sow with all the best grass seeds, and use this portion of their farm specially for grazing-cows and beef-cattle, as the case may require. Arrange the remainder of the farm under a course

of rotation of cropping, say five-course system. By so doing the farmer divides the labour of his farm to be done in course and not in a few weeks. This saves the cost of keeping so many horses, which, to do them justice, consume in food their real value every year, and are of no particular use to the farmer. It would also be a great item in the way of saving manual labour, and altogether a more pleasant, enjoyable and profitable occupation."—*Jos. Fisher, Ingersoll, 1883.*

"I propose to place the remainder of the farm under a system of five-course rotation. He thereby reaps annually more valuable mixed food for animals, with a portion of wheat for market than by any other course I have observed either in Britain or in Canada.

"For example, allow the farm to be one hundred acres, the least boundary a farmer will attempt at dairy-farming in this country. Also allow twenty-five acres as permanent pasture, and five acres for bush, leaving seventy acres to be placed under rotation of cropping. Under this system all the manure made upon the farm can each year be placed upon an average of fourteen acres, the space allowed for the team to work upon. Fallow, or grow rape upon clay part. Clay loam or sandy loam soil can be planted with corn, sown with horse-tooth mixed with millet or Hungarian to cut green and cure for feed. Grow carrots, turnips or mangels. All these are essential for carrying on dairy farming. Sow this portion cultivated thus with grass seeds and grain the following spring, thereby having one-fifth of seventy acres in roots and feed generally, two-fifths in grain of different kinds, also two-fifths in hay, making the course complete, and supplying the requirements of a dairy farm for maintaining at high pressure, the year round, a valuable herd of dairy cows.

"This course, followed with a small outlay on artificial manure to assist green crops annually, would so improve the farm as to produce as much grain from half the land ploughed, and receive as clear profit nearly all the proceeds of a large dairy, over and above the profits of the present prevailing custom."—*Jos. Fisher, Ingersoll, 1883.*

Fertilizing.

"The best manure is that which contains the many elements required to make rich land, which is, undoubtedly, barnyard manure. Next to this are the green manures, and first and foremost among these is clover. Of the patent manures offered for sale I regard them mostly as fit to class among the humbugs; for this reason, they are so largely adulterated that they are of little value, and even if pure the price is such as to make their use impracticable. On almost every farm exists, if properly saved and manageable, sufficient manure to supply its wants. Were the money spent in buying artificial manures used for the draining of wet soils, the loosening up of subsoils, and for the converting of waste matter into manure, much better results might be obtained. Every farm should have its compost heap, where all *debris*, refuse of all kinds, leaves, sods, swamp muck, etc., could be piled. It is surprising what a valuable lot of manure can be gathered up in the year in this way."—*W. P. Page.*

"The second letter in the dairy alphabet is "M," which stands for "Manure." I condemn the reckless waste of manure now so common, and advocate the practice of more rigid economy. The exposure of manure heaps to the sun and air was a fruitful source of waste, by the evaporation of volatile gases by the sun, and the dilution and carrying away of the soluble elements by the rain. It is necessary, therefore, to house the manure, and this could be effectively done by means of a rough board shed."—*W. F. Clark.*

"I manure my meadows when they seem to need it—as a general thing every three years—top-dress in the Fall, and pulverize the manure by running over it a light harrow, which it in. Manure needs to be broken up fine to be fitted for grass roots. I put manure on top.

"It does harm to harrow the sod so as to open it up before top-dressing."—*Lewis.*

"I have also practised with good effect drawing manure about Christmas, and spreading on fall-ploughed land. By the use of the cultivator and harrow as soon as the land is dry in the spring, such manured land can be brought into the very best condition for turnips or corn. But when this is practised, the land should be moderately level."—*F. Malcolm, Ingersoll, 1883.*

Profitable Farming.

"We have received a letter from a valued correspondent whose early life was passed on a Canadian farm, who has made scientific farming a study, and who has seen the world from New Orleans to Jerusalem, always with an observing eye to farming systems. This correspondent wishes through the *Alpha* to call attention of Canadian farmers to a new and simple way of at once, and cheaply, bringing back to heart impoverished soil, and increasing the number of live stock, especially of cattle, and more especially of dairy cows. The plan proposed had been already suggested to a farmer a few miles out of Ottawa and the, what must be called wonderful, success attending an enthusiastic appreciation and hearty adoption of it has encouraged others to try it, and it is rapidly spreading. This farmer had a farm in poor heart, two-thirds under cultivation. His stock was two horses and six cows. He cut usually less than two tons of hay to the acre—barely enough to well feed his small stock. The plan that he was led to adopt involved the simple principles of (1) an economical use of everything available for fertilizing purposes; (2) the better enriching and thorough cultivation of fewer acres, and (3) the planting of (Illinois) corn for (green) fodder, to be used as a substitute for hay for cows. The saving of waste material was the excellent beginning, the liberal use of the product favoured the planting of the corn fodder, the harvesting of abundant fodder favoured the purchase (in the winter when cheap) of more cows, the feeding of the more better than formerly of the less, the better health of the cows, more milk and profit—and then in turn a still larger production of even more rich fertilizing material! The investment paid the farmer legitimate usury and more than compound interest at that.

"The plan adopted to save *and utilize* all waste material was as simple as efficient. It was the building of a cheap out-house for manure. Into this house was gathered loads of forest leaves, vegetable stalks, straw, weeds,—everything that could be picked up to be at once valuable in practical use, and "good riddance as bad rubbish." The work of picking up and storing this material was done in the fall season. Through the winter all the manure was thrown into this same receptable, and it was so arranged that the stables were easily washed daily, of course to the great benefit in health of animals, and the wash ran into the out-house and was taken up by the material that, as a perfect absorbent, awaited it. It is not perhaps to be wondered at (though some few doubters may not believe it) that, as a result of the first fall and winter's enthusiastic adoption and working of the new plan, the farmer alluded to was able to carry upon his farm not the ordinary twenty, but *seventy* loads of manure; and of a quality that the land had known little about before—it had not wasted its substance in rain soakings, sun-dryings and wind-liftings. The sequel of the little extra labour and small outlay of means was as follows: The first summer following, five tons instead of two tons of hay were cut. The second year the six cows have increased to fifteen, and he keeps the *larger stock on fewer acres of ground*, leaving, of course, more good ground for wheat, of which, too, he raises a larger quantity per acre, and of better quality. It is easy to see that in every way things are getting better since his land has been put into better heart, and feels like answering each season's calls made upon it. Before long the whole farm is brought into a high state of cultivation to the yearly profit and daily comfort of the owner. A day labourer working by the month had for years always used up his wages weeks before due, and always bought and used to a disadvantage, or positive loss; but he has once managed to get ahead, and now he is enjoying more comforts while laying by something every month. The difference between what the farmer in question was a few years ago and what he is to-day, is similar to the case of the once thriftless labourer compared to his now improved condition. We commend this manual arithmetic to our farmers, and suggest that they subtract from their time a few fall days that would otherwise be devoted to less valuable objects, add to their resources some of the big wastes about their places, carefully watch the multiplication of the results of their new efforts, and divide their accumulated profits among themselves and families, laying it out in better buildings, improved machinery, more comforts, better libraries, larger educational advantages, etc., etc."—*The Alpha.*

"Mr. Lewis, of Herkimer, N.Y., has practiced this system with great success. He commenced some years ago by taking twenty-five acres of land which were then of only ordinary fertility. These he underdrained and seeded to timothy, clover and orchard

grass, and began to top-dress with liquid manures. He uses saw-dust for the absorption of the liquid manures, and for this purpose it is spread in the stable behind the cows. As fast as the liquids are absorbed by the saw-dust, during the winter, they are hauled immediately to the field and placed in piles. In spring these piles are spread as evenly as possible over the surface with a fork or shovel. Then he goes over it with a brush harrow, which completely breaks up and distributes the manure in fine particles. He uses basswood dust from seasoned wood, and which is obtained at a neighbouring match factory.

"By this practice he has for some years past been enabled to get from this meadow a quantity of hay sufficient for the winter keep of fifty cows."—*Willard.*

Manure Cellars.

"There has been great difference of opinion whether manure cellars under the stable are injurious or otherwise.

"Many barns in Central New York are constructed with the cellars under the stables, and in no instance where they have been properly ventilated, and absorbents used for taking up the liquid manure, have I heard of any bad effect on account of the manures, etc. The stock is quite as healthy, and appears as thrifty at all seasons, as in barns without manure cellars.

"I have examined manure cellars under stables, at different seasons of the year. Some of them were badly ventilated, and were foul with gases emanating from the decomposing mass of excrement which had been dumped without absorbents. Such a condition of things must be a source of disease to stock and cannot be recommended. In others, where ventilation has been secured, and absorbents, such as muck, dry earth or sawdust freely used, the atmosphere was comparatively pure, and free from any disagreeable odour. Generally those who have manure cellars under their stables are pleased with them. They save a great deal of labour in the course of a year, and, with the precautions I have named as regards ventilation and absorbents, have not been found to be objectionable."—*Willard.*

"I bed my cows with dry basswood saw-dust, which absorbs the liquid manure, and so mixes with the other that it does not cake, and breaks up as easily as horse-manure."—*Lewis.*

The Management of Manure.

"It should be as much a study how best to make manure in the winter, as it is to produce milk in the summer. The success of the whole thing depends on the fertility of land, and this cannot be kept up without returning an equivalent of some kind in the shape of manure. It is a very common opinion that a farm may be enriched by dairying, but this is a mistake: that is, as dairying is generally practised. The fertility of the soil stands to the owner's credit the same as would a deposit in the bank. And although everyone knows the effect of drawing on a deposit, it becomes less; many seem to think the more they draw on the deposit of fertility the larger it becomes. They do not seem to be fully alive to the fact that every pound of cheese sold from the farm removes a certain amount of that fertility. So that it is just a matter of time for such a process to reduce any farm to a run-down condition. To simply put back the stable dung mixed with straw bedding is not an equivalent, even suppose there was no waste by fire-funging, the washing of rains and in the form of urine. The question is, how is this difference to be made up? It may be done by the purchase of artificial manures, but if this has to be resorted to, it will pay well to take more care of that produced on the farm than is generally done.

"Another plan, and I think a better one, is what I have before referred to, and to some extent have practised, that is, the feeding of purchased food. Those who make a business of feeding beef generally resort to this largely, and I can see no reason why it would not pay dairymen to do it.

"In purchasing bran or chop stuffs, three or four dollars per ton should always be counted for the manure, and if the farm is badly run down, a much higher figure.

"But with all attempts to keep up the fertility of the farm, none can be practiced with greater utility, than greater care with the manure pile. Here is where the first great improvement can be made with very little trouble.

"I know it is generally recommended to build sheds, but they are so expensive and perishable, that most farmers think they will not pay, and perhaps this is true, if the best methods in their absence was practised.

"Instead of dumping the manure wherever it is easiest, it should be kept in a compact heap, similar to the lower part of a stack; the size of the foundation depending on the quantity to be deposited. In such a pile fermentation and heat will go on all through winter, and by the 1st of May it should be six feet deep. By a little contrivance most of the urine may be spread on the top daily. In the spring any leakage should be collected in cavities made for the purpose near the pile and thrown back on the top, especially in such places where the heat is greatest."—*F. Malcolm, Ingersoll, 1883.*

Working the Soil.

"An indispensable requisite to good farming is good soil. If your land is not in good order, rich and mellow, the first step will be to make it so. This may seem a simple thing to do, but with a worn out farm, or one naturally poor it is not so easy a task. Plenty of manure, properly applied, with thorough draining, will do it. But we have different kinds of soil to treat. The lack of one certain element in the soil may make it appear poor while it has a superabundance of other elements; hence the necessity of a scientific knowledge of the soil.

"One source from which manure can be obtained is the air, and secured by frequent stirring of the soil. We frequently hear it said, land should have a rest, allowed to lie idle for a time, expecting after years of idleness it will be enriched. This is a great mistake; if continually stirred it will draw richness from the air, but if left entirely idle will be little benefited. This is especially true of sandy soils. 'Feed the land and it will feed you,' is a maxim as true as it is old.

"Next in importance to manure comes the subject of *drainage*, and in this the farmers of Ontario are seriously deficient. No soil, I care not how rich it may be in the elements required for plant food, will yield its fruits to the husbandman when saturated with stagnant water. With a system of thorough underdraining, not forgetting surface drains, for these are a necessity also, the capabilities of our farms can be increased to a surprising extent. When the soil is saturated with water the air is excluded from the roots of the plants and prevented from acting upon the manure: while the low temperature produced by continued evaporation from the surface has a powerful effect in retarding the progress of vegetation. Among the essentials requisite to maintain a high degree of success in farming is a proper system of rotative cropping. The advantages of rotation are well known, yet the practice is very common to grow the same kind, or similar kind of crop for years on the same spot of ground. Opinion is somewhat divided on the principles upon which the beneficial results attending systematic change of crops are based. Some support what is termed the repletion or excretary theory which proceeds on the supposition that the roots of all plants during their growth give out certain substances peculiar to themselves which impregnate the soil to such an extent as to render it unfit for the growth of that particular plant, but having no deleterious effect upon the growth of a different family of plants if, indeed, they are not rotten, to be considered as capable of promoting growth and acting as stimulants to such. It is a well ascertained fact that certain, if not all, plants do impart to the soil through their roots a portion of their juices. The soil surrounding the roots of the oak tree is found to be impregnated with a substance known as tounin, and similar facts might be quoted with respect to other trees. This theory is supported by high authority, yet I am not a believer in it, but support the theory that although plants are made up of the same primary elements, yet different species require them in widely varying proportions so that each plant has a characteristic formation peculiar to itself. It therefore follows that if there is a lack of a particular ingredient required for any plant, that plant will not be maintained in healthy growth. Any crop grown on the same land continuously will sooner or later exhaust the elements peculiar to that crop, and the crop will grow smaller, while perhaps

the same ground would grow an abundant crop of some other kind. In a practical view it is evident from either of these theories that a change of crop is requisite. To give a definite rule for rotations I will not attempt, but will say this without fear of contradiction, for I know the experience of all present will bear me out in saying that in general, long, tuberous, watery plants, as carrots, beets, mangels, etc., should be followed by those that root near the surface. Plants that are cultivated for their seeds should be followed by those grown for their foilage. The seeds of all plants contain a larger amount of the mineral ingredient than their leaves, so that plants grown for their seeds will exhaust the inorganic matter of the soil to a greater degree than will be effected by plants grown only for the use of their leaves. Various courses or systems of rotation have been suggested. I will not offer any particular rotation; observation is the best teacher in this."—*W. P. Page.*

"Lucerne does well where you have a dry, rich, sandy loam. On such a soil it will send down its roots twelve feet and prove most profitable."—*Lewis.*

"If your pastures are seeded down with but one kind of grass, you have to wait for it, and when it matures you have nothing. But if you stock your pastures with different grasses, you will have a constant succession, one maturing after the other, and always something fresh for your cows."—*Lewis.*

"How long will your meadows stand without breaking up?"

"As long as it snows and rains. With an occasional top-dressing, they are growing better every year. They will never run out."—*Lewis.*

Laying Down Pastures.

"In seeding for permanent pastures, a greater variety of seeds should be sown than is commonly employed. The grasses are evidently social in their character, and delight to congregate together. From a single sod in a rich, natural pasture as many as thirty varieties have been counted. If we mix the varieties of early and late blooming, we get not only a succession for feed, but also a heavier growth upon the land. The mixture of varieties recommended by Mr. Flint is excellent, and may be advantageously adopted. He recommends for seeding the following proportions:

Sweet-scented vernal, flowering in April and May	1 pound
Meadow fescue, May and June	2 "
Meadow Foxtail " "	2 "
Orchard grass " "	6 "
June grass " "	4 "
Italian rye grass, June	4 "
Perennial rye grass "	6 "
Perennial clover "	3 "
Timothy, June and July	3 "
Red-top " "	2 "
Rough-stalked meadow, June and July	2 "
White clover, May to September	5 "
Total	40 pounds

"To this we should add, blue grass *(Poa compressa)*, three pounds, and Alsike clover, three pounds.

"The objects sought are, to get our pastures as thickly covered with as good a quality of herbage as our soil is capable of growing, and to have them bear stocking early in the spring to withstand drought, and to continue to yield a 'good bite' all through the season.

"To accomplish this, it will therefore be necessary for us to ascertain which of the cultivated grasses are best adapted to our particular soils, and in what proportion they should be sown.

"I shall not attempt to recommend a particular mixture of seeds, but will merely give a general description of some of our best pasture grasses, and the quantity of seed per acre generally sown in mixture with other grasses, and leave each one to select such

as may seem best suited for his soil and purpose. If we take them in alphabetical order, we shall find first, *agrostis vulgaris*, a very common grass in some districts.

*"*Agrostis vulgaris*, or red-top, is well suited for permanent pastures, but it should be fed close, otherwise it becomes wiry—grows in any soil moist or dry—and stands our hot seasons well. I think it is over-estimated by most farmers, and worth more for lawns than for pastures—2 to 3 pounds.

"*Anthoxanthum odoratum*, or sweet vernal grass (6 pounds), should be introduced into all mixtures for permanent pastures, on account of its early spring growth, as it is also one of the latest in the autumn—luxuriates most in rich cool soils—¾ pound.

"*Alopecurus pratensis*, or meadow fox-tail (5¼ pounds). This is one of our very best pasture grasses, being quite early, much liked by cattle, and withstands our hot summers without burning. It flourishes best in a rich, moist, and rather strong soil (1½ to 2½ pounds.

"*Dactylis glomerata*, or orchard grass (11 pounds), is, in my opinion, the most valuable grass we have, and should enter largely into all mixtures intended for permanent pasture. It is one of our earliest, as well as most nutritious and productive grasses, and is exceedingly palatable to stock of all kinds. As a pasture grass it should be cropped close (4 to 5 pounds).

"*Festuca duriuscula*, or hard fescue (9½ pounds). This is not so productive as some of our pasture grasses, being one of the fine and dwarf-growing varieties, still it is desirable as thriving well in dry situations, and withstanding drought better than many other kinds (2 pounds), of the numerous varieties of the fescues.

"*Festuca pratensis*, or meadow fescue (13 pounds), is the most desirable, and it is one of our best grasses, producing a large bulk of very nutritious grass, highly relished by cattle, does not attain its full growth until three years from the time of sowing; prefers soils of good quality (3½ pounds).

"*Lolium Italicum*, Italian rye grass (15 pounds). Occupies the same position among grasses in England as timothy does here. Is remarkable for its early maturity and rapid reproduction. I have not succeeded in growing it satisfactorily here, but I think it can be done, as it succeeds well in the dry Australian climate. If it can be grown here it will become one of our standard grasses (6 to 8 pounds).

"*Phleum pratense*, or timothy (44 pounds). Is so well-known that it needs no description. More valuable for meadows than pastures, as it will not bear close grazing (3 pounds).

"*Poa pratensis*, or blue grass (13½ pounds). Is common in most sections of the country, but prefers limestone lands. Starts early in the spring and remains green until checked by frosts (1½ pounds).

"*Poa trivialis*, or rough-stalked meadow grass (15 pounds). Much like the blue grass in appearance, except that the one has a smooth and the other a rough sheath. It is one of our most valuable grasses, highly nutritive, and both cattle, horses and sheep are very fond of it (2 to 4 pounds).

"The above are some of the most valuable of the grasses; the list might be extended, and I should always recommend sowing in a mixture with above grasses, red clover and *trifolium repens*, or white clover, say 3 or 4 pounds of each per acre.

"Mr. George Sinclair wrote a very instructive essay on grasses, in which he says, after advancing some reasons why a variety of grasses should be sown, 'There is another important law in the natural economy of the grasses which governs all those species of most value to the farmer. It is this, that individual plants of the same species will not grow close to each other for any length of time, for, however thickly planted from seed in one or two seasons, intermediate plants decay and leave vacant spaces, which are soon filled up with spurious grasses, weeds or moss; but when a variety of different species adapted to the soil are mixed together, they grow close, form a dense bottom and continue permanent.'

* The numbers immediately after the name of grass indicate the average weight of the seed per bushel. The numbers after the description, the number of pounds generally sown per acre in mixture with other grasses.

"That is just what we want in this climate, 'a dense bottom,' to withstand our scorching sun and dry summers, and to obtain which we must have a variety of grasses." —*Willard.*

Seeding.

"So far as we know, the scientific world has not yet found a better or more profitable food for the production of milk than the grasses, either green or properly cured. Of these the varieties are numberless; so numerous are they, indeed, that it is said that they comprise one-sixth of the entire vegetable kingdom. Nutrition and productiveness considered, the Kentucky blue grass stands at the head in the order of excellence; next following, the best posted investigators of the question place the variety known as orchard grass. These, when mixed in equal quantities, with lesser quantities of several other varieties make the best known pastures.

"There can be no question but that a mixture of several varieties of the grasses (and the greater the number of varieties the better) will secure a larger yield to the acre than any single variety, and, if the tastes of beasts are like our own, the result will be a much more palatable food. Moreover, when we consider the liability of any single variety to suffer by the frosts of winter, we discover a strong argument in favour of a mixture of varieties; the close and matted turf secured by this method, operating like the fur of animals to protect the roots against the operation of frosts."—*Harris.*

"Mr. Brown said he would commence by asking the audience to get some idea of permanent pasture and green fodder. It was not a new subject, as he spoke upon the same subject at Belleville. He thought that many Canadian farmers did not know what permanent pasture meant. They all knew what timothy and clover were, and they often thought that a permanent pasture was good from them. He contended that, in order to get a permanent pasture, the chief difficulty was not to maintain the grass as to know what to seed down with. In order to show what he meant by a permanent pasture, he would say that at the farm at Guelph they had permanent pasture which they had held for seven years and with which they had done a good deal. They could grass three beasts per acre, and they had been grassing eight, nine, and ten sheep per acre on what they called permanent pasture. He was not going to enter into the value of permanent pasture, for he considered that nothing more reliable for feeding cattle had been discovered in England or any other part of the world. Chemistry said this was so, and practical farming proved its value, whether for beef or sheep. At Guelph they had been experimenting for the last eight years, and the idea was growing strongly in favour of that position for the Experimental Farm. He thought it might be taken for granted that what would grow and do well at Guelph, 900 feet above the level of Lake Ontario, would grow anywhere in Ontario. He now proceeded to give a statement of grasses with the quantity of seeds per acre in order to produce permanent pasture. The first was timothy (7 lbs.), which he had found would not stand drought, and was not quite equal to orchard grass as regards this, but in other respects better. Orchard (4 lbs.) was second, because their experiments showed it to be a stronger plant. This seemed to be a selfish, some might say a conservative, plant; it seemed to grow in clumps rather than in individual plants. Next came Italian rye (2 lbs.), and Perennial rye (2 lbs.), which were the great fodder crops of England and Scotland, though he had never succeeded in maintaining these ryes, unless in association with other grasses. Though they could not grow these grasses separately as a green fodder crop, they were the grasses which, in the neighbourhood of Edinburgh, brought a rental of £30 sterling per acre, as from some fields there had been cut 100 to 150 tons of grass per acre. Fan out (2 lbs.), red top (2 lbs.), meadow fescue (3 lbs.), bent (1 lb). Of the clovers there were Lucerne (4 lbs.), white (3 lbs.), red (1 lb.), Alsike (1 lb.), yellow (1 lb). Of the whole, he spoke most highly of the Lucerne, which he described as a magnificent plant. They would see that there were 35 lbs. of seed, 10 of clover, and 25 of grasses. Some of the farmers would think it was too much, and they would probably think 17 to 21 for the ordinary rotation pastures. Mr. Brown proceeded to show that with the mixture he had suggested there would be grass early and late, and it was only in this way that a permanent pasture could be obtained.

"In the discussion which ensued it was considered that what was called June grass in Canada was of the same family as Kentucky blue grass, and that the latter did succeed as well in Canada as in Kentucky."—*Dairymen's Convention.*

Permanent Pastures.

Professor Brown, of the Agricultural College at Guelph, gives a list of grasses and clovers for permanent pastures in Ontario. He advises thirty-five pounds *per acre*. They are proportioned as follows:—

Grasses.		*Clovers.*	
Timothy	7 lbs.	Lucerne	4 lbs.
Orchard	4 "	White	3 "
Italian Rye	2 "	Red	1 "
Perennial Rye	2 "	Alsike	1 "
Fan Out	2 "	Yellow	1 "
Red Top	2 "		
Meadow Fescue	3 "	Clovers	10 "
Bent	1 "	Grasses	25 "
Kentucky Blue	2 "		
		Per acre	35 "
Grasses	25 "		

"Men who make farming a science have for years been telling us how much grass seed ought to be sown upon each acre of meadow land, and it still remains a fact that not one farmer in a hundred will follow their instructions through fear of dropping a few seeds more than are actually necessary, forgetting, in their over-anxiety to save a few pennies, that it is far better that a half-dozen seeds germinate where but one ought to than but one grow in a space where six might flourish. We have often heard men debating the question as to how much seed ought to be sown upon an acre, and we have seen them divided in opinion by one pound, and we have been tempted to ask these philosophers to tell us the nature of the calamity following the distribution of a pound too much? It is much easier to conceive of an under-seeded meadow or pasture than an over-seeded one, and it is a fact that in nine out of every ten cases meadows and pastures are not more than half seeded."—*Harris.*

"A larger quantity of seed and a more diversified list of varieties may be used in the seeding of pastures than in meadows, for the reason that in meadows care must be taken to mingle only such varieties as ripen at the same time; while in pastures varieties differing widely in their habits are desirable, it requiring no great effort of the perceptive faculties to understand that varieties ripening successively, one after another, through the season, are preferable for grazing purposes to only one or two. There are some men, however, who cannot understand a proposition as plain as this seems to be."—*Harris.*

"Your milk, with your system of seeding, costs too much, and you must remember you have to compete with oleomargarine butter and pigine and pig's grease cheese, and if you want to hoist them sky-high it has to be done by furnishing a perfectly pure product at moderate prices.

"When you seed down now, you put in so much timothy and clover, and if you change at all it is to sow clover and timothy. It is timothy and clover or clover and timothy every time. Now timothy is not a good pasture grass. It looks handsome; indeed, I know of no more beautiful sight than a field of timothy when heading. But its value is overrated. The roots are small and onion-shaped, with no good hold of the soil, so that the cattle pull it out in feeding or tread it out, and when a drouth comes it is all gone, and you would have no pasture for your herds were it not that nature comes to your aid and starts, in place of the timothy, June or Kentucky blue grass. I advise you when preparing them to make your meadows rich, and when you have manured them well, add a little more manure. Don't spread the manure deep, but keep it near the surface. Prepare the land like an onion-bed and then sow it with this mixture: Take of timothy five or six pounds, four pounds of roughstalk meadow grass, four or five pounds of foul meadow grass, and now I come to a grass with which you are all familiar, and which is destined to overrun this continent—five pounds of red top, and last of all five pounds of meadow fescue. We have but few grasses that mature at the same time, so I give a few kinds that mature earlier and others later than timothy. To the grass seeds

I have mentioned add six or eight pounds of clover. I like the large red clover myself. Besides what you cut of it clover helps the land. Its long roots penetrate the soil deep, and bring up plant food to the surface, and when it dies, as it will in two years, these long roots decay and leave holes in the soil. You remember the boy that drove a nail for every good deed he did, and drew out one for every bad act, leaving a record of holes. Well, the clover leaves holes as useful to the farmer as when filled, for they help to underdrain the soil, they get full of water, and the sun draws it up for the nourishment of the grasses. I don't regard clover as desirable in a pasture, but sow it more for the good it does the soil. The quantity of seed I have mentioned is calculated for an acre. Sow as early in the spring as you can, and I would no more think of sowing a grain crop along with it than I would of using my grandfather's love-letter. Grain overshadows the young grasses when they need all the light and heat they can get, so that they grow spindly and come up no larger than a hair, and then, while thus weak, your grain gets ripe and you cut it, with the result that as soon as you remove the shelter from the weak grasses they are sun-killed in a few hours, and you have to re-seed. When sown alone the grasses come up strong and healthy, and thrive with an exposure that kills what you thought to shelter by sowing grain along with it. When sown alone you will have a fair cut that fall of this mixture: fourteen pounds of orchard grass, ten pounds of Kentucky blue grass, and a little timothy added. My quantities are all for one acre. You may think they are too large, but if the seeds all grow they will come up thick as hair on a dog's back, so that there will be no bare spots, and the fittest will survive. Do not attempt to pasture it the first year, but mow it in the beginning of September, and leave the aftermath for a protection. I have found it very convenient to have an early-maturing meadow, and this I have got by sowing ten pounds of orchard grass, eight pounds of Kentucky blue grass, and six pounds of small clover. Of this you can cut a good crop twice the same season as seeded. A meadow so seeded will do to cut the first or second week in June. Put it by in some place where you can feed it handily to the cows, night and morning, when the pastures fail in July or August. The cows will then come for it of their own accord without a dog or brutal man to drive them at milking time. You will find such early cut grass better for your cows than growing corn. In seeding grass, use a fine harrow before sowing, and then roll well if the land will allow it. If there are too many stones or stumps for the roller, take a fourteen-foot scantling and fasten beech limbs to it, attach your team and brush the land. If you can both brush and harrow it will pay you to do so. By pursuing this method, and which is that I have followed for years, you can make three blades of grass grow where you have only one now, and have a succession of growths all through the season. You can never stock your pastures with two many kinds of grass. One variety of grass by itself will not thrive very well nor make a sod, but if you introduce other varieties they will fill up the entire available space and grow luxuriantly. The grasses are social in their habits, and where the soil is properly fed twelve will do well together. And by increasing the varieties of grasses you vary the food of your cows, and do not confine them to timothy at morning, noon and night, for they have all these deep-rooted, fibrous grasses to live on."—*Lewis.*

"My first remarks tend to encourage farmers to procure a portion of *permanent pasture* on their farms as a key to success in farming, which I cannot but admit is procured, in its luxuriant state, in this country, with some difficulty, on account of the soil being robbed of its natural fertility, and its supplies of every ingredient which a crop requires, not being so far decomposed as to be of use to plant life; therefore, if these ingredients are not available as food, it is no practical use or advantage to a growing plant, that the soil should contain food which will not be ready for use until next year, or two years, or ten years.

"We will, therefore, consider the most economical way to replace that food required to maintain healthy plant life, as the fertility of a soil is determined by the quantity of that essential food which is present in the least proportion, and not those which are plentiful.

"This can be most cheaply overcome, and a luxuriant permanent pasture encouraged by preparing the soil by cleaning, cultivating, etc., applying best farm-yard manure from meat-

making animals on the most barren parts of the field, also apply bones, half-inch bones fermented bones, or bone-dust, as the case may require, to encourage growth of various grasses. I would prefer fermented bones at the rate of about 600 pounds per acre. This fermentation is accomplished by placing half-inch bones in a heap, moistening them with water, covering them with saw-dust or fine earth. In a short time they become warm, and when they have been so treated for a few weeks they become softened, and when sown and harrowed into the land they mingle with the soil, and are more quickly ready for supplying phosphate of lime, most essential to encourage the roots of the various grasses, and will continue to do so for years, as the chemical changes take place which prepare them for absorption into circulation as plant food. Also apply one-half bushel of barley per acre, and sow a mixture of various grass seeds before rolling. Avoid an excess of red clover; by so doing you will procure a healthy pasture, and circumstances which make land more healthy for plant growth, make it more healthy and profitable for animal life.

"This permanent pasture being successfully established upon a farm, is, I consider, the foundation of all successful dairy farming. It may not produce the quantity of grass in bulk every year, but the herbage is more nutritious to the animal and more palatable to the taste, and the milk, butter, etc., are all of superior quality, more sure to keep sweet and clear from nauseous smell and rank taste, than milk and butter made from the annual clovers so generally sown in this country and grazed by dairy cows.

"Permanent pasture also modifies or regulates the produce of cows during the months of August, September and October (when according to custom cows are allowed an extra field of timothy aftermath, or other pasture), and for dairy farming generally is the most profitable plot of land on the farm."—*Jos. Fisher, Ingersoll, 1883.*

Location of Pastures.

"Pastures, it may be remarked, should be located upon uplands or well-drained soils. This is of great practical importance. The grass upon swampy or wet lands not only yields an inferior quality of milk, but milk often highly charged with the elements of putrefaction. When pastures are wholly or mostly composed of low or wet lands, the herds are liable to become more or less diseased. Foot-rot, bloody murrain, and febrile diseases are not unfrequent. I have known bloody murrain to be so virulent on such lands that they had to be abandoned; but by under-draining the land and returning to pasture the stock was rendered healthy.

"The excessive drain on the animal system in the production of milk has an important influence on this class of animals, rendering them less able to withstand disease than those that are not yielding milk; hence they require more favourable conditions in their management than other stock."—*Willard.*

"Usually old pastures, if they are kept free from weeds, need no renovating except what naturally takes place during pasturage. It takes from two to four years to produce the grazing capacity of lands newly sown to grass that is ordinarily found in well-preserved old pastures. This is owing to the close math that covers the ground. Where weeds cannot be kept down by the animals grazing, the only effectual remedy is the plough. Sometimes, where the soil is of a poor and unproductive quality, excellent results may be obtained by giving it a liberal top-dressing, and then sowing grass or clover seed upon it, and passing lightly over it with a harrow. I treated a piece in this way last spring, sowing equal parts of white clover and red top seed. There was a vigorous growth of grass that kept green and luxuriant during the heat of summer and until late in the fall. I have treated meadows in a similar way with good results. On meadows, however, it is better to apply the top-dressing in October and seed with red clover and timothy."—*W. R Gray.*

"Will the grasses you tell us of make good merchantable hay?"

"It will not to those who do not know any better. There is a prejudice among city people in favour of timothy, but hay of the mixtures I have spoken of is really worth more. I have not sown timothy alone for fifteen years. My pastures and meadows are

all seeded down with a mixture of grasses, and I would not change back to timothy or clover on any account."—*Lewis.*

"Farmers lose thousands of dollars by cutting their hay too late. They wait till it becomes over-ripe, woody, and has in it every principle that makes a cow kick up her heels. Cut early, even if it costs more to make it then. Rain does not injure early cut grass. Cut as soon as your first head of timothy comes into flower. If you leave it longer it takes nothing from the soil, but loses its quality as feed. In sowing a mixture of grass some kinds will be behind others. Do not wait for them, but cut as soon as the first timothy heads among it come into blossom.

"To steer clear of risk of giving horses the heaves we may cut hay three days before it comes into blossom."—*Lewis.*

Management of Pasture.

"Many of our farms are partly composed of land unsuitable for cultivation, what has been probably swamp. Those places should be drained at least sufficiently for the growth of good grasses, and all fast growing weeds and brush kept down by some means till the grass has a firm footing. Land of this description may be made the most profitable on the farm by getting it into grasses of the right kind. Even pastures on cultivatable land will soon become very unsightly and unprofitable if not attended to with scythe or hoe. Weeds are a trouble to the grain grower, but they are a curse to the dairymen. If cows are so kept they will eat almost anything, they will not give much milk, and what they do give will not be good.

"But the greatest mistake with pastures is *overcropping.* It is supposed if cows are not kept in sufficient number to eat all that grows, there is a loss. We have all heard the expression: 'I might just as well have had three or four more cows as not; my pastures are knee deep.' This may be true, but more likely it is not. It is a law in all plant life, that in order to have a large top it must have a large root, and it is equally a law that in order to have a large root it must have a large top at least once a year. However good the root may have been, if the plant is persistently deprived of its top, it will soon come to have a relative proportion to that top, and produce very little.

"Canadian thistles may be killed by simply cutting off the leaves. They may be kept feeble by keeping the top feeble. We see the operation of this law in our turnip fields when worms eat the leaves, or among our potatoes when the bugs are destructive. Even our apple trees do not grow if their leaves are destroyed, and pasture grasses are no exception. By understanding the law of plant life, and acting accordingly, better pastures might be obtained.

"But pastures under the best management are only for a time. They must not be depended on for the whole summer. Dry weather and heat generally turn all brown, and cows suffer except something else is provided. From the 20th of June till the 20th of August is a critical time for the dairyman. To be successful something must be done, for it is a well known fact that if cows are allowed to fall off very much they cannot be brought back to their milk that season. They may increase in flesh, but they won't milk."—*F. Malcolm, Ingersoll, 1883.*

Over-Stocking.

"Many dairymen habitually over-stock their pastures, thus not only doing great injury to the grasses, but the cows, from an insufficient quantity of food in a given space, are required to travel long distances in quest of food, and thus the yield of milk is diminished. By this practice the roots of the grasses and the whole plants are kept so small that their growth is feeble, and not one-half the feed is afforded that the land would produce if stocked properly and the grass allowed to get a good, thrifty start. But this is not the only disadvantage to the pasture from over-stocking. The feeble growth of the grasses allows other plants to creep in, and the ground soon becomes overrun with weeds, which, on account of their not being cropped by stock, grow in great luxuriance, maturing their seed and thus impoverishing the soil. The curse of American dairying to-day is

weeds. When once they get full possession they become so formidable that the farmer is often disheartened and gives up their eradication. It is always advisable to pull up or exterminate bad weeds on their first appearance in pastures, and not allow them to spread. There are many weeds that cows will eat during a dearth of nutritious food, that gives a taint to the milk, and thus are prejudicial to a fine quality of butter. When pastures are over-stocked, or when they are not yielding a sufficient supply of good, sweet, nutritious feed, additional rations should be allowed the cows, such as bran, ground oats, shorts or mill feed, corn fodder, cut grass, or some other forage plant."—*Willard.*

Experiments.

"Take a plot of land, divide it into squares, and try the difference in grasses, in order to learn which best suits your soil. There are several kinds which will not grow on my farm. The tall, oat grass, Italian rye grass, bunch, and buffalo grass have failed me."—(*Lewis.*)

"Select a bit of each of your farms, and one strip dress with ashes, another with barn-yard manure, another with phosphates, another with lime, and you will find out which your land is most in need of.

"Even a chemist by analysis might fail to tell what your soil lacks, but you can ascertain yourselves by the experiment I have suggested."—*Lewis.*

2. INCREASING THE MARKET VALUE OF THE PRODUCT.

Increasing Quantity of Product.

The second requisite is to increase the market value of the product. The market value will depend on two things, quantity of production and quality of product. One condition of increase of market value will be that the different products of milk be in quantities to meet the demand. There are two products of milk—butter and cheese. If all the milk were turned into butter there would be too much butter and a lack of cheese. It is desirable that the production of the two articles be adjusted somewhat near requirements of the market. This is a condition that has only to be touched upon, since it largely regulates itself, and the individual dairyman has to take it into account only in a local way. Each dairyman will produce the article that he finds best adapted to his location, and gives him the most profit.

Improving Qualtity of Product.

The other condition of a large market value is the most important of all. It is the quality of product. There is no other factor in the problem of so much importance as this one of quality of the milk product. Quality is an important consideration in everything produced by the farmers, or made by the manufacturer, but in butter and cheese it is even more important than in anything else. Butter and cheese are first luxuries, and only secondarily necessaries. At their best they are both. It is only as luxuries that they become necessaries. They are luxuries only when fine in quality. When the quality depreciates to a certain degree they do not satisfy the appetite, and cease to be luxuries. Not meeting the want as a luxury, they cease to be necessaries. The demand is for an article of a luxurious character, and when the supply of the article falls short it is satisfied with a substitute, and failing a substitute, is satisfied to go unsupplied. The demand grows or falls off according as it is fed or unsupplied. Quality, therefore, affects the quantity of consumption of butter. It affects both the *demand* for it and the *actual sale* of it, and thus doubly affects the *price* of it. The effect of quality upon the market value is greater in the presence in the market of a substitute for the milk product. When the quality is inferior to the quality of the substitute the demand is transferred to the substitute. This effect is enhanced where the quality of the milk product depreciates by being kept. The substitute becomes a disturbing influence of no little importance. All this is especially true of butter as a matter of fact to-day. Its general quality is low ; it has a poor keeping quality, and there is a substitute for it in oleomargarine, which, put upon the market fresh made, has pushed back the slightly rancid butter to be sold later, after further depreciation in quality, not as a luxury or even a necessary, but to be used in the place of *grease*.

I have said that the increasing of the market value of the product has, perhaps, more to do in the solution of the problem than has the cheapening of the cost of production. This would be true of dairy products, as it might not be true of some other farm products. For instance, it would be true of butter, as it might not be true of oats. The products of the dairy, as marketable commodities, differ in some essential respects from most other farm products. There is a difference in the value of different samples of oats, but the difference is slight. It is a difference of a small per cent. The difference between different samples of butter ranges up to not ten, fifty, or even a hundred per cent., but it may be to several hundred per cent. The difference between the two classes of products lies not alone in the market value, but in several other things that are important market factors. Grain is a necessary ; butter is a luxury. Grain has a value that may be almost determined by mere weight ; the weight of butter means nothing until its quality has been determined by examination and test. The examination of grain very closely appre-

ciates its quality; the quality of butter can be only approximated, by even the most expert judges, for what would be accepted as good by one consumer would be called inferior by another, and the keeping quality cannot always be known by the appearance. Grain is something that is easily stored or transported, and with little risk of depreciation in quality; butter can be held or transported only with special precautions, and is liable to serious depreciation in value. Grain is little subject to fluctuations from the introduction of a substitute; the butter market has had its peculiarly difficult conditions complicated by the introduction of a substitute, oleomargarine, etc.

Anything, therefore, that will make the market value of the product satisfactory is of first importance. To lessen the *cost of production* means a gain, but at the best not a gain in proportion to the possible gain in giving the product its *highest market value.* Indeed, it is only when the product shall have a high market value that a lessening of the cost of production shall count in profits as it ought. Butter, if it does not meet the market conditions, may sell at so much of a sacrifice that it will not bring a return covering the cost of production, however low that cost be reduced. On the other hand, butter may so well meet the demands of a market that it will give a large profit, even though the cost of production be extravagantly high. When it is remembered that butter is every day being sold for from seven cents to one dollar per pound, the above statement will be admitted. There are few table luxuries the taste for which becomes so exacting as it does for butter. After the use for a time of the really prime quality of butter, it becomes less of a self-denial to do without altogether than to go back to a compound somewhere between lard and grease. This fact accounts for the fancy prices that are paid by people who, once accustomed to the best, cannot bear the inferior grades.

Relative Demand for Good or Poor Qualities of Butter.

"Is it true that the public will give no more for a good than a poor article?" "The public readily give a good price for a good article. Our experience is that we can sell choice butter at any price, while an inferior lot is hard to get rid of." . . . "If some large dealer would make a specialty of keeping good butter, and get a reputation for it he would soon attract so large a portion of the best trade that other dealers would be forced to follow his example." . . . "Is it true that people do not know good butter, as a rule, and are not willing to pay for it?" "Not at all. We find it almost impossible to work off a really poor article, and generally dispose of it to the bakers at a reduced price. Sometimes it is so bad that it is only fit for the soap-boilers. We pay a high price for some special lots, and have customers willing to pay for it."—*St. John (N. B.) Dealers.*

"Those who make good butter have no trouble in selling it at the highest prices. The finest American butter realizes from three to four shillings a pound in the cities of New York, Boston and Philadelphia, and this is the American butter-maker's reward for skill and watchfulness, for cleanliness and care. The butter of the Danes, the Dutch, the French, and the Germans, which is of excellent quality, takes the lead in the best English markets. One hotel manager imports his butter direct from Normandy, because he fancies he cannot get butter good enough in so good a dairying district as Derbyshire. The Danish and German butters are held in high estimation, and Dutch butter is sold as the finest Dorset in London."—*Prof. Sheldon.*

"The sooner the butter-makers of Canada and the States wake up to the fact that the great bulk of their butter has to compete with what is now termed Oleomargarine, Sardine and Sueine, and in many cases sold as butter, the better; and what is more, most of this artificial butter is preferable to most of the genuine article. Our senior, when in England this spring was surprised to find many buyers giving a preference to these artificial compounds on account of their uniformity and mildness, and genuine butter, slightly stale, very much neglected. A few years ago there was no difficulty in selling all grades of butter at some price or other, but owing to the enterprise and ingenuity of our American and Continental friends they have convinced John Bull that these artificial compounds are more nutricious than over-kept, stale, and rancid butter. We know of thousands of packages of genuine butter, but stale and over-kept, shipped from the States (termed

ladle packed), and also Canada Dairy and store packed having been sold this spring at prices ranging from 40s. to 50s. in the English market, which would only net the owner 7c. and 9c. per pound, while fresh landed lots of artificial butter from the Continent and the States were selling at 70s. to 80s., and finest fresh landed parcels of States and Canadian Creamery and Dairy butter at 100s. to 110s., which proves conclusively that the preference is decidedly in favour of choice fresh uniform lots of butter, but rather than have stale butter they will take these artificial compounds."—*Messrs. Hodgson's Circular, 1881.*

"Major H. E. Alvord, of East Hampton, said the 420 tons of butter shipped from Greenfield to Boston last year had netted the makers only 24½c. per pound, while western factory butter had averaged 10c. per pound more, and that made at the Hatfield butter factory brought 3c. to 5c. more."—*Greenfield Butter Convention.*

"Americans get a higher price for their butter at home than they could in the English market. There is no doubt in my mind that in many of our larger cities there are people who would be quite willing to pay a high price to a man who established the quality of his butter. If a man established the reputation of his butter, fancy prices would be paid in Toronto and Montreal as in cities of the United States."—*Mr. Ashley, Brockville, 1883.*

"The trade in Canadian butter may be increased to an almost indefinite extent, provided the article be good in quality and attractive in appearance, and there is no reason why as good butter should not be made in Canada as in England, if it is given proper care and attention, and until we do so we need not try to compete with the butter made in English dairies or imported from Ireland and Denmark."—*Prize Essay, Ingersoll, 1883.*

Effect of Quality on Consumption.

Just now the larger proportion of butter used is doubtless of a quality under the average, but the change foreshadowed that will lessen the demand for the poorest, and strengthen the demand for the best, is sure to take place. Unvitiated appetites, as well as educated epicurean tastes, will find poor enjoyment in a diet that includes butter that is salty, greasy, rancid, be it spread upon large surface of bread, or disguized in intricate cooking. Already there is a great range of prices for different qualities and yet, in spite of the always strong argument of pocket, there is a sharp demand and easy sale of the best when the other is a drug in a slow market.

An appreciation of the present state of things and the probable constant change always in the direction favourable to *quality* is the key-note to success in our dairy industry.

The first and most important thing with the butter-maker, then, is to increase the market value of his product. The increase in the value of the product having been attained, he has a further inducement to lessen cost of production. So long as the product is of an inferior quality and brings a low return in the market, the producer will hardly be successful in lessening the cost of production to an extent to make his dairying profitable.

What has been already said points out another important fact. It is this, that the market value of the dairy product is almost wholly a question of *quality*. The first and most important thing, then, for the dairyman to do is to improve the quality of his product.

Quality will meet all the peculiar market conditions of the product, so far as they can be met, and lack of quality will put everything at its worst. Not only prices, but *the very sale* of the article are dependent upon quality. There is, therefore, no more important question for the dairyman to consider than this one, how the quality of his dairy product may be improved. Authorities have spoken plainly and often upon this subject. Let us heed them.

The Present Bad State of the Dairy Industry as to Quality.

"There is one branch in which, somehow or other, we are not improving as we ought, in fact I fear we are actually going back. I allude to butter-making, and it is a

branch of farming in which we lose a large amount of money yearly."—*Col. Laurie, in N.S. Journal of Agriculture.*

St. John (N.B.) dealer interviewed by *Sun* reporter—

"There is not more than ten per cent. of the butter that comes to market fit to eat, and I see nearly all of it. The other ninety per cent. is bad."—*St. John (N.B.) dealer interviewed by Sun reporter.*

"Housekeepers assure us that they have almost begun to despair of getting an article (butter) that is fit to eat. They devote more time to the search than ought to suffice to discover the North Pole, and yet they rarely discover the package of butter that can be depended upon to keep sweet and good. People on every hand are crying out for a remedy for this evil. Life is too short for so much time to be devoted to the search for good butter, and too valuable to be risked by the eating of the quality usually offered for sale in the market."—*St. John (N.B.) Sun.*

Leading butter-dealers in the city and country are unanimous in the claim that but a small percentage of the butter is good and fit for market. In a prize essay published in *Farmers' Advocate* for September we find the following incidental reference:—"Thousands of pounds of this commodity have been shipped to the Liverpool market from this country at a loss to the exporter, the article having been so badly made as to turn rancid during transport, and it has finally been used as axle grease for car wheels."

Quantity vs. Quality.—An objection is sometimes made to any improvement in method which, instead of giving a larger quantity of butter, gives less. No wise butter-maker will give any weight to such objection. The loss in quantity, if any, can be an insignificant item, while the least improvement in quality adds a considerable proportion not only to value but to chances of making an easy and good sale. At the worst the loss of quantity can be only four or five per cent. Three per cent. of salt more than the taste demands will make butter over-salted. Less than three per cent. of buttermilk left in the butter would depreciate the keeping quality and perhaps spoil the sale of it. When the market price for ordinary butter is twenty-five cents per pound, butter defective from over-salting and excess of buttermilk, adding five per cent. to weight, may sell with difficulty at fifteen cents per pound. Here is a loss of forty per cent. from bad quality to set against a gain of five per cent. in quantity. Wherein would be the gain here?

But this is not all. One unwise enough to risk reputation for a supposed small gain, which was really a large loss, would be likely to follow defective methods that would lead to further loss. It is not an unusual thing to lose upwards of five per cent. in raising cream, in the care of the cream, in churning, etc. The writer has seen a loss of thirty per cent. in churning cream of different degrees of ripeness. The improved method teaches the proper washing of butter to free it perfectly from foreign matter, and to salt to the taste, not to make it keep, and much less to add weight; but the improved method teaches the setting of milk in a way to obtain quantity of cream, and the keeping of cream and churning it in a way to get the largest proportion of butter from it. The loss in one way can be but a trifle, say five per cent., the gain to offset that loss may be a large item,—from ten to thirty-five per cent. Thus it is illustrated in ordinary practice that looking to quantity as against quality may entail from the different factors of quantity and price a loss of upwards of fifty per cent., and it may reach 100 per cent.

The importance and value of the consideration of quality over that of mere quantity is so apparent that it would seem a waste of space thus to point it out. The reason, however, for calling attention to the matter is the fact that butter-makers, and even butter-dealers, when some improved process is taught, ask: "Will it not decrease quantity?"

It is no new thing to show that there is no loss in making quantity subordinate to quality. Mr. Lincoln, who received the first dairy premium of the Massachusetts Society for the Promotion of Agriculture, perhaps more than a quarter century ago, early gave his opinion on the matter. He says: "I am aware of the truth of the objection made that the shrinkage occasioned by its use is too great; yet there is, in fact, a difference in the worth of the butter made upon it, over that in the ordinary way, quite equal to the loss in weight occasioned by it."—*Flint, 1860.* Here Mr. Sinclair

refers to the use of the butter-worker and the consequent more complete extraction of the buttermilk. He might have put the case more strongly, and it may be even more strongly put to-day, when the value of butter depends more upon quality than ever before.

"I wish I could say the same about the progress in the butter-making industry in the Province. I find from the statement of the Minister of Agriculture lately made in the House, that there are 50,000,000 pounds of butter made in the Province every year, and if this had been made of good quality, the value would have been increased from five to fifteen cents per pound; but we will take the medium of ten cents, and we find that the Province has lost at least $5,000,000 in the year. This is fearful when we stop and contemplate the loss. No doubt every farmer thinks his wife knows all about butter-making. No doubt she does, but the same primitive appliances are used, and the result is not the best. Take the case of a farmer with ten cows, averaging 200 pounds of butter in the season, and at five cents a pound loss, owing to the butter not being the best, or not keeping as well as the best—we find that, after slaving heart and soul out of wife and children, he had lost $100."—*Address of President of Eastern Dairymen's Association, 1883.*

Essential Qualities in a Good Sample of Marketable Butter.

"When the grain of the butter is broken, its keeping qualities are lost forever, so we shall carefully guard the grain of butter."—*Lewis, 1883.*

"When the grain is all right butter may be kept under great disadvantages and almost anywhere. If the grain is spoiled it will hardly keep long enough under any circumstances, and the flavour is about as much affected as the keeping."—*Arnold.*

"The grain is such an important factor in the make-up of fine butter that it is necessary we should be very particular not to injure it in any way if we would excel in the art of butter-making."—*Arnold.*

"When a piece of butter is broken in half it should present the appearance of fractured cast iron; it should be granular and globular—that is, not greasy and oily."—*Sheldon.*

Keeping Quality.—"We buy large quantities in the country, much of it from men whose butter we have found to be good, and much which we find to be good on careful inspection, and yet we frequently find that it will not keep."—*St. John dealer.*

"Butter that is well freed from its caseine requires less salt to preserve it, and it thus remains fresh butter to all intents and purposes, and is worth more money in the market."—*Prof. Sheldon.*

Uniformity.—"The increase in the number of creameries is a step in the right direction; it gives us a more *uniform* quality, and in consequence enhances the value. . . . It is not many years back when most of the cheese was made in a dairy *with as many sizes as there were boxes*, but now, with the aid of factories, we get a more *uniform* grade of cheese, and a class of goods that is always marketable."—*Hodgson & Son's Circular.*

"They (the country dealers) often buy it in small lots, and pack it themselves, and so three or four kinds and colours are sometimes found in the same tub." . . . "They (the farmers) bring it into market in all shapes and colours, sometimes a half dozen shades in a package."—*St. John (N.B.), dealers on Bad Butter.*

Appearance.—"The manner in which butter is presented to the public is an important point, and the Irish farmers would do well to discard their clumsy firkins for neater ones, and the railway folk ought to be careful not to dirty them by rolling them about in the mud."—*Sheldon.*

"The whole should be pleasing to the eye, as we often please the palate through the eye."—*Lewis, 1883.*

"The efforts being made to get butter to market in a well-preserved and tasty form are worthy of all encouragement. There is no article of food which appears in the general market whose market value is more affected by its appearance than butter. The neater and more tasty the form in which it can be presented the greater price will it bring, the

better satisfaction will it give, and the more will there be consumed to give a demand for an increased production."—*Arnold.*

"The writer, a few days since, saw a Toronto produce merchant weighing some butter packed in a tobacco pail. The original label of the pail, in all its beauty and suggestiveness, was still on the pail—a fair proof that the policy of the packer was not to throw away any money for appearance sake, nor even to waste any water for the sake of cleanliness. Can it be doubted that what was saved in the use of the second-hand pail was more than offset by the diminished price that came from flavour alone—which was like that from the stem of an old tobacco pipe."—*W. H. Lynch, in Canadian Farmer.*

"It has been well remarked by Mr. Stephens that when butter is properly churned, both as to time and temperature, it becomes firm with very little working, and is true, it becomes firm with very little working, and is tenacious, but its most desirable state is that of waxy, when it is easily molded in any shape, and may be drawn out a considerable length without breaking. It is only in this state that butter possesses that rich, nutty flavour and smell which impart so high a degree of pleasure in eating it and which enhances its value manifold.

"It is not always necessary to taste butter in judging of it; the smooth, unctuous feel in rubbing a little between the finger and thumb, expresses at once its richness of quality; the nutty smell indicates a similar taste, and the bright, glistening, cream-coloured surface shows its high state of cleanliness."—*Willard.*

Defective Methods and Poor Utensils as a Cause for Bad Quality of Butter.

"Of course there are various qualities of milk, and some breeds of cattle are more profitable than others for butter-making, but it is mainly in the *manipulation* that the difference between good and bad butter arises."—*Col. Laurie, in N.S. Journal of Agriculture.*

"I should hesitate to utter a word that might seem to depreciate the efforts now made to improve our stock, but we shall miss a point if we spend all our energies to get good milk and go on in the old careless way, making it up into greasy butter that possesses no keeping qualities. While careful selection of stock and right care of it will give us better results in quantity and quality, let it be borne in mind that there is almost no average cow's milk from which good butter-makers will not make what would always pass for good butter, and there is no stock so good whose milk may not be worked up by poor butter-makers into bad butter."—*W. H. L., in St. John Telegraph.*

"Our farmers seem to be without proper knowledge of butter-making, and without the necessary appliances for making and keeping it. They bring it into market in all shapes and colours, sometimes a half-dozen shades in a package." "The makers of the bad butter don't work it enough in the first place, and thus part of the buttermilk is left in it to turn sour and spoil the butter. Secondly, they don't use proper salt; and thirdly, the packages are not tight enough to exclude the air and keep foul odours from the contents."—*St. John (N.B.), dealers.*

In Ireland some of the finest butter on the London market is made, yet it is authoritatively stated that "Ireland exports its butter at about ten to twenty shillings per hundred weight below the prices obtained by the foreigners," and the reason given for the bad Irish butter is "over-salting, not taking the water out of it, the use of bad and inferior firkins, etc."

"There has been, in other directions, during the last quarter century, an advance that is truly wonderful. Outside, the mowing, reaping, and even binding is done by machinery. Inside, farmers' wives and daughters are beset with agents selling sewing machines, wringers, organs, etc. But the dairy is supplied much as it was when the farmer swung the monotonous flail and scythe. It is still the open milking-pail, the little pans, the old dash churn, or possibly some patent churn that is little or no improvement, no butter-worker, no cream-holder, no suitable package, and—must we say it?—not even a fifty cent thermometer. We welcome, then, any enterprise that will bring up the dairy work to a line of advance alongside of other work. Let us have home butter-making

made easier; let the profit on that work be greater; let our tables be more bountifully supplied with the golden balls, and let us have an improved foreign butter trade."—*Canadian Farmer.*

Quality Dependent upon Method and Appliance.

"The high reputation of Philadelphia butter-makers is owing to the manner of its manufacture, though I would not say that the sweet-scented vernal and other natural grasses do not add to the fine quality of well-made butter.

"In proof of what I say I would refer to the experience of my brother, who is the owner of two farms. His tenant, an excellent butter-maker, lived on one farm, and made a very fine article, which brought the highest prices. He moved to the other farm, where the former tenant had never made good butter, and had ascribed his want of success to the spring-house. On this farm he succeeded in establishing a higher reputation than he ever had before. The tenant who followed him on the first farm never succeeded in gaining a reputation for good butter, his inability arising from his ignorance of the proper mode of manufacture, and his unwillingness to improve by the experience of others."—*Flint, 1860.*

Where good butter is made with imperfect means it is the exception, and even those who succeed might have done still better if better equipped. Said Mr. Flint, in 1860:—"Many good dairy-women make an exceedingly fine article, in spite of the defects of some parts of the process of manufacture. This does not show that they would not make still better butter if they remedied these defects." And if good butter-makers would thus improve, much more would poor butter-makers improve by the use of what even many good butter-makers deem essential.

"A more general attention to the details of butter-making, and to the best modes of preserving its good qualities, would add many thousands of dollars to the aggregate profits of our American dairies."—*Flint, 1860.*

"The enormous waste of milk and labour annually incurred in abortive attempts to manufacture these articles will be prevented, and a quality of goods produced which will be a credit to us, either in the home or foreign market."—*Toronto Board of Trade Report, 1882.*

In the opinion of the most competent agriculturists, whatever may be the method followed, only three-fourths of the butter contained in the milk is obtained. Evidently the remaining fourth is not lost, but is to be found in the skim-milk and buttermilk, which, as everyone knows, is used in making cheese and as food for man and beast.

The creamery is also supplied with all the appliance for securing perfect cleanliness, pure air, and the proper temperature of the milk, all of which are essential in good butter-making, and are most wofully neglected in the majority of farm-houses. Consequently the creamery produces an article far superior to general run of dairies, and of a uniformity impossible to be attained by them.

"If the dairy could be supplied with these, there is no doubt that it could produce butter far superior to any creamery, as milk that has been agitated and partly cooled, before being put into the pans, never gives such good and plentiful cream, or such a good quality of butter; therefore, there could be a higher quality of butter produced from milk that had been carried directly from the cow to the cooling pans, than could possibly be obtained from that which had been jolted over miles of rough road to the factory."—*Prize Essay, Ingersoll, 1883.*

"Although certain breeds of cows and certain kinds of foods have a great influence on the colour of butter, the general appearance is due to the mode of manufacture, especially working and packing."—*McNames, Brockville, 1883.*

"In my opinion the keeping qualities of butter depend principally upon two things. First, the buttermilk must be all got out; and, second, the grain of the butter should be kept as perfect as possible. Butter should not be allowed to be churned after it has fairly come, and should not be gathered compact in the churn to take out, but the buttermilk should be drained from the butter in the churn, through a hair sieve, letting the butter remain in the churn. Then take the water and turn it upon the butter with

sufficient force to pass through the butter, and in sufficient quantity to rinse the buttermilk all out of the butter. With this process of washing the butter the grain is not injured or mashed, and is thus far kept perfect. And in working in the salt, the ladle, or roll, or worker, whatever it is, should never be allowed to slip on the butter: if it does it will destroy the grain; but it should go upon the butter in a pressing or rolling motion.

"Butter should never be hurried in the packing, but should have time to cure, and time for the salt to dissolve; for the chemical action of the salt will, after a time, separate the buttermilk from the butter."—*Willard.*

Improved Methods and Better Utensils as a Remedy.

"A great change in the process of butter-making is rapidly taking place; new ideas and theories are wiping out old-time notions; the aged little milk-pan and clumsy dash churn are going to wreck, and the milk itself is being submerged. . . . I do advocate a more thorough investigation of improved apparatus for butter-making, and a more enlightened knowledge of different methods than many seem to think necessary."—*Miss Morley, taker of Sweepstakes Prize, New York, December, 1879.*

"It is *mainly* in the manipulation that the difference between good and bad butter arises."—*Col. Laurie.*

"The Danes, the Dutch, the French and the Germans bestow great pains in the making of their butter, and they follow out the most approved systems, adopt the best and most modern utensils, study the principles of their art, which are propounded to them by scientific teachers, and the result is that their butter takes the lead in the best English markets."—*Prof. Sheldon.*

"A well-constructed dairy, cleanliness, temperature, careful attention to details, and proper utensils, are the chief requirements in butter-making."—*Prof. Sheldon.*

"His cows were Jerseys and Guernsays, but he did not regard the breed or feed so important as cleanliness in the stable and neatness in the whole process of making butter."—*E. F. Bowditch, of Framingham, Mass.*

"In closing, I wish to refer briefly to the erroneous idea, so prevalent among people generally, that only those of long experience and mature age can excel in butter-making. Just abandon this fancy, and give us younger people a chance, and we will show you we are willing to learn, and, having learned, are competent to manufacture the real gilt edge. Hon. Hiram Smith, a few weeks ago, expressed as his opinion, that for any intelligent person to learn all he *needs* of butter-making requires from ten to twelve days' experience. The length of time, however, depends somewhat on how many erroneous lessons he has to unlearn. Though my own experience does not fully coincide with Mr. Smith's ideas, still I think if this work of butter-making be transferred from the patient, tired hands of *mother* to our own, we shall be in possession of an attainment, an *accomplishment* in the highest sense of the word."—*Miss Morley.*

The Dairy.

"For the home dairy a good cellar is the best place to control the temperature in the hot weather. It should be properly drained, and thoroughly cleansed and deodorized by removing all decaying or strong smelling substances; then, after whitewashing and strewing the floor with lime, if an earth floor, and allowing the fresh air to circulate freely for some days, the milk may be set in it. We consider a dry, porous earth floor the best for maintaining a pure atmosphere in a cellar, as it rapidly absorbs carbonic acid, which from its greater specific gravity than pure air always sinks to the lowest levels. As milk readily absorbs volatile matters it is of the first importance that the air of the milk-room should be pure and untainted, as well as sufficiently cool."—*John Smith, Ingersoll, 1883.*

"Particular attention should be paid to the milk house, cellar, or dairy, in which the milk is kept, it should be of a uniform temperature of from 50 to 55 degrees Fahren-

heit, moderately light, and easily kept clean and well ventilated. Probably the best plan is to have a 'spring-house,' as there is no better way of preserving the equal temperature that is necessary for the best management of a dairy than the use of a permanent spring of water, and the temperature of a spring, summer and winter, is as nearly as possible that which causes cream to rise most rapidly and completely, which is a very important point in butter-making.

"Besides evenness of temperature, pure air surrounding milk and cream is essential, and a stream of pure water will secure this, as there is no better absorbent than pure water.

"The odour of milk fresh from the cow is rather disagreeable, and if not got rid of, remains in the butter, injuring its flavour and keeping qualities. A current of water flowing through the milk room will carry off all that odour, besides keeping the air moist, so that the cream does not become dry and leathery, as it does in dry, airy milk-rooms. The perfect cleanliness which may be secured where there is an abundant supply of pure water is another of the advantages of a good spring-house.

"This plan is, of course, intended for the prevalent shallow-pan system."—*Prize Essay, Ingersoll, 1883.*

Cleanliness.

"Let cleanliness be applied—to the cow-house; see that it is kept clean, so that no foul odours shall be absorbed by the new milk, and that the animals may be kept healthy, so as to give pure, wholesome milk; to the udder, so that no scabs or filth may be rubbed off into the bucket while milking; to the hands, so that they shall not defile the milk; to the spring-house or vault, that the cream may be kept pure; to the milk-bucket, pans, skimmer, cream-pot and churn, so that no cheesy taint or foul odours be communicated to the cream; and, finally, to the butter-worker and market tub. To all these, scrupulous cleanliness should be applied."—*Agricultural Paper.*

"The dairyman also knows full well that the quality of the butter depends in a great measure upon the milk, whether it has been kept clean or not. If the milk becomes foul in the stable, no amount of neatness afterwards will bring back the flavour and the perfection that would otherwise have made it easy to obtain the highest price in the market. The writer has seen cows milked, the milk from a single one of which would taint that from a large dairy. For cows to be properly milked it will require that they be cleaned before milking, that there may not be any dirt to fall into the pail. This carding and brushing should not be confined to the udder, but should extend over the whole body, as it is an important item in their healthful keeping, as well as a means of obtaining clean and pure milk."—*Country Gentleman.*

"There is a small ice-chamber at the end of the oblong butter tub which we use in summer, so that in dog-days the heat within the tub does not get higher than 60 degrees Fahrenheit. "I need not add that we observe a scrupulous, a religious neatness in every act and in every utensil of the dairy. Milk which upon leaving the udder passes through an atmosphere loaded with stable fumes will never make butter for which we can get a dollar per pound. No milk sours upon the floor of the milk-room; none is permitted to decompose in the crevices of the milk-pans; the churn is scoured and scalded till no smell can be detected but the smell of white cedar."—*Willard.*

Milk and Manure.

"Milk was important as well as manure. The objection to them was when they get together. Farmers would find they make a poor mixture."—*Lewis.*

"With regard to the ornamentation of the butter, he would strongly recommend those who put hairs in it, to secure, if possible, very black or bright red hairs for their white butter, as less pronounced tints did not look well. He thought yellow butter looked well enough without any hairs."—*Lewis.*

"I have seen filthy cows in a filthy stable, and milk drawn into filthy pails by a filthy milker, and the milk I have regarded as the *perfection of filth.*"—*Lewis, 1883.*

Milking.

"Briefly, the end in view in milking cows is to empty the milk-vessels completely by means of a progressive pressure, exerted first by the thumb and index finger, and subsequently by the rest of the fingers. Part of the milk will be left behind unless good care be taken not to strangle the nipple, as it were, at its base before pressing it, thus rendering part of the force applied of no avail. Inexperienced persons think they get on faster by proceeding hastily to the alternating movement required in milking. This is a very great mistake, resulting in an incomplete milking, to begin with, unnecessary fatigue to the operator, and a good deal of distress to the cow. The milkers should always have their nails cut short, and if a cow's teats are painful from inflammation or other cause, care should be taken not to increase her sufferings."—*American Cultivator.*

(Gentle Treatment.)

"No milker should either speak harshly, or roughly treat his cows, or allow others to do so. Treat milch cows as if they were pets, and they will reward their owners at the pail twice every twenty-four hours."—*American Paper.*

(Frequency.)

"Tho difference in the quality which may sometimes be observed between the morning's and evening's mess, is chiefly due to unequal distance of time between milking, the milk being richer at night when the days are short, and richer in the morning when the nights are short. When the times between milkings are equal, the yield and quality have proved to be similar. A difference sometimes occurs where cows are more comfortable and quiet during the night than during the day, or the reverse, as when suffering by cold in winter, or by flies in summer, when more and richer milk follows, the greater comfort." —*Arnold.*

"In a great many farms this is done three times a day during the first months of the milking season, and afterwards twice a day. By this means, not only is more milk obtained, but milk which is richer in butter. It is admitted that the oftener a cow is milked, the richer is the milk in butter."—*Barre.*

(Regularity.)

"At the creamery at Ridge Hill Farm, in the State of New York, it was found to take 20 per cent. more of milk to make a pound of butter when the cows were milked at irregular intervals, a fact which dairymen should remember. Milking should not only be regularly done at the end of every twelve hours, but so far as possible by the same milkers, that is to say, every milker should milk the same cows morn and evening."—*American Paper.*

(Completeness.)

"Drawing all the milk perfectly from the udder at every milking, not only prolongs the flow, but it keeps the bag in good condition. By leaving milk in the bag it becomes crowded and inflamed before the next milking, drying up the milk and injuring the bag." —*Arnold.*

"Frequent, perfect, and regular milking is, therefore, a very efficient means of promoting a flow of milk, and preventing change in its quality, for so long as a large flow can be maintained, so long will it maintain its earlier characteristics."—*Arnold.*

Falling Temperature.

"By long and careful experiments it has been ascertained that *the more speedily the milk is cooled down, the more completely is the cream separated from it.* The consequence is, that not only is much colder water now used for cooling the milk, but the pails for

setting it have been reduced to the smallest diameter consistent with the other management of the milk."—*X. A. Willard, 1875.*

The above shows that the effects of a falling temperature were noticed, but attributed to other cause. The impression seems to be that it was the low temperature, not the fall, which obtained the result. Rapid cooling had the effect, now acknowledged, of leaving the cream thin, and more or less mixed with milk, thus deceiving as to real quantity. The above is found on page 149 of "Willard's Practical Butter Book." On page 151 of the same book, we find it stated that cream raised by cooling in water so low as 35°, "rises very suddenly, but it is at first *very thin, and requires a longer time to become firm.*"

On page 150 Mr. Willard furnishes further incidental proof of the principle of a falling temperature, but does not seem to recognize the principle, and practically states that the matter is unsettled, requiring the proof of "careful experiments." He says:—

"The milk should be delivered as soon as possible after the milking is done, and carefully transported, and it has hitherto been considered advantageous to cool the milk during the process of milking, and before being delivered. However, it has recently been stated that the more the original heat is retained until the milk reaches the factory, the more cream will the milk yield, as the cream begins to rise *as soon as the milk begins to get cold*, and the straining and transportation of the cool milk causes a very injurious interruption in the rising of the cream, which consequently will be imperfect. This seems probable, but can only be proved by careful experiments. It is, however, a fact, that the shorter distance the milk is transported the more cream does it yield."—*Willard.*

There is no question as to the advantage of cooling milk *for transportation.* There is no question as to the loss in cream-rising by the *interruption* in straining, cooling and transporting milk. Mr. Willard at this time evidently was in doubt about the matter. The only question is, would it be a disadvantage to cool *for transportation* the milk intended for *setting to raise cream*, and would that milk if set afterwards, *without having been warmed again, raise its cream?*

Prof. Willard, at the Canadian Dairymen's Convention, 1882, gave an address in which he shows that he had settled some of these mooted points. He says: "Warm milk transported long distances is liable to spoil before reaching the factory, and requires to be cooled at the farm if it is to be delivered sound and in its best state." It seems at this point to be understood that there is need for cooling milk at the farm, not to help the cream to rise but to admit of its being transported. What follows is an incidental, not direct, argument in favour of falling temperature. After detailing experiments showing the loss in setting travelled milk cold, as against heating it before setting, Prof. Willard says: "The important lesson for American butter dairymen to learn from these experiments is, that all milk that has fallen below 80° Fahr. when it arrives at the butter factory should be heated to 104° before setting. That the loss on milk cooled at the farm before transportation is very considerable if set at the factory without heating, amounting on an average to twelve per cent.; and as it is essential that milk should be cooled at the farm before transportation, dairymen should understand, and especially should these butter-makers who purchase milk, that a gain of twelve per cent. of butter can be saved by heating such milk. It will be seen that thousands of dollars annually are thrown away by the butter factories from not knowing these facts."

It is the truth of the last remark which makes necessary in this connection so much being said to set forth the right principle. Evidently, one may use the words of those who do not accept Mr. Arnold's theory of a falling temperature, *both to prove its correctness and its immense importance.* How Prof. Willard has escaped the theory, it is not easy to say. On the one hand cold-setting is claimed to be the right system, and on the other hand the milk to be cold-set must not itself be cooled when set, but, if cooled for some other purpose, must be *first warmed up to at least* 104°. Surely the fall from 104° to ice-water temperature is a "falling temperature!"

It may be supposed from our quotations from Prof. Willard, that this authority was at this time an advocate of the theory of a falling temperature. Judging from other parts of the same address, it would seem that he had not yet accepted it. He speaks of

the fact that "after the Swartz system began to be put in operation it was observed that milk creamed with more facility that had *not been cooled at the farm before transportation.*" In the same clause he speaks of the discovery of Swartz "that if milk be cooled nearly to the freezing point, the cream will rise very rapidly," as "overturning the statement of Springer and other high authorities, that cream rises with greater rapidity above 55° Fahr. than below that temperature." From this one would gather that Prof. Willard up to this time accepted the cold-setting and not the falling temperature theory. But in supporting the theory that cream rises better at a low than a high temperature, he unconsciously gives the low temperature the benefit of the fall from a higher temperature, as against an unchanging high temperature without any advantage from a fall.

Miss Beecher's Cook Book, published so long ago as 1846, advises heating milk, after it has set ten or eleven hours and cooled, and setting it again to cool, thus securing more cream (page 206). The practice was understood, but not the principle. Mr. Flint writes as though he *practised* the principle :—

"Particular care should be taken not to let the milk get cold before placing it in the dairy-room ; for, should it be completely chilled, the cream will not rise well."—*Flint, 1860.*

"The whole principle of the Swartz system consists in rapidly cooling the milk, that is to say, without loss of time and immediately after the milk is taken from the cow and still warm at blood-head, 26° to 28° Reaumur, or 91° to 96° Fahrenheit; it must be at once dipped into iced water and brought down as rapidly as possible to a temperature of 32° or 33° Fahrenheit."—*Barre.*

"It will be observed, then, that in order to get the best results from this principle, the milk should always be set at a temperature of 90 degrees. If the temperature of the atmosphere reduces the milk in the process of milking to less than 90 degrees, it should be heated to the temperature named, and then chilled in the manner I have mentioned." —*Prize Essay, Ingersoll, 1883.*

"The first prominent fact in the separation of cream from milk is, that it rises by reason of its having a less specific gravity than the milk with which it is mingled.

"The average specific gravity of milk is about 1,030. The difference between this and 985 brings the cream to the surface ; it is so little that the cream makes haste very slowly. The globules never all come to the surface. Other circumstances being the same, the largest ones rise soonest, as they are specifically lighter and in rising meet with less resistance in proportion to bulk than the smaller ones. Many of these never make a start toward the surface at all. Neither do the larger ones always rise, some of them settle instead of rising. In placing in a glass tube sixteen inches long, milk on which the cream appeared to rise perfectly, leaving a blue skim-milk, and letting it stand twenty-four hours, and then drawing milk from the bottom of the tube, globules of good size ($\frac{1}{100}$ of an inch in diameter) appeared mingled with the smaller ones. As globules of unequal size remained at the bottom, it is evident they did so because of a difference in their composition which made them specifically heavier. Those remaining at the bottom of a deep vessel appear less opaque than those which rise to the surface, those rising first, being the most opaque. Analyses of skim-milk show that about one-eighth of the fatty matter in milk never gets to the surface.

"The smaller the globules, the slower they rise ; and some of them dwindle down to such minuteness that they would not rise through three inches in a week, if the milk could be kept sweet that length of time. Cream will continue to rise till the milk gets thick, be that time short or long. The best part rises first. If milk is skimmed every twelve hours, and the cream of each period churned separately, the product of the first period will be the highest flavoured and the highest coloured, and the colour, quantity and flavour of each successive skimming will diminish to the last, but the keeping qualities will grow better. The fourth and fifth skimmings will be quite pale and insipid. Where a high flavoured article is desired, it is not advisable to continue the process of creaming too long. What will rise in forty-eight hours, at sixty degrees, on milk four inches deep, is all that is generally profitable to separate. What comes up after that is so white and tasteless as to do more injury, by depressing the flavour and colour, than it can do good by increasing quantity.

"The second essential point is the fact that fats expand and contract more with heat and cold than water, and more than the other elements of milk. The difference in specific gravity between milk and cream is varied by the circumstance of temperature. It is greatest when hot, and least when cold, and this fact materially affects the rising of the cream.

"As fat, of which cream is chiefly composed, swells more with heat and shrinks more with cold than water, of which milk is chiefly composed, it is evident that, if other circumstances are alike, cream will rise better in a high temperature than in a low one, since the fat in cream, by swelling more with heat, will be relatively lighter when both milk and cream are warm than when both are cold—the temperature in both cases neither rising nor falling, but standing without change. Most people seem to have the opinion that milk must be cooled to make the cream rise fast, and that the colder they can get it, the faster the cream will rise. The fact is exactly the reverse when the temperature is stationary. The colder the milk, the slower the cream rises, because there is less difference between the specific gravity of the cream and milk, and because the milk is more dense and offers more obstruction to the motion of the cream globules. It does not rise as fast at 60 as at 160 degrees. In butter-making the waste of butyraceous matter is confined almost wholly to the minutest particles of cream. These rise with great difficulty and very slowly. Those who make butter from whey often heat the whey to 170 degrees, when the difference in specific gravity between the fat in the cream and the water in the whey becomes so great that the cream all rises to the top in a short time. By cooling to 60 degrees, five or six times as much time is required to effect the same result.

"In noting the difference of expansion in water and fat, by varying the temperature, the fat in rising from 60 to 130 degrees, swelled, as near as I could determine by graduated tubes, twice as much as water by the same increase of temperature. Water expands unequally by an equal increase of heat according as the increase is made at a high temperature or a low one. Water rising from 40 to 50 degrees swells only one-tenth as much as when rising from 80 to 90 degrees, and in cooling, of course, the same law is followed in the shrinkage. In falling from a high temperature to a low one, the water in the milk shrinking little and the fat much, the specific gravities come nearer alike, and hence the fat rises more slowly at low temperatures than at high ones, when the temperature is unvarying. Water is a better conductor of heat than fat; hence, when the temperature of milk varies either up or down, the water in the milk feels the effect of heat or cold a little sooner than the fat in the cream does; therefore, the cream is always a little behind the water in swelling with heat or shrinking with cold—thus diminishing the difference between the specific gravity of the milk and cream when the temperature is rising, and increasing it when the temperature is falling. The difference between the specific gravities of milk and cream, when both have the same temperature, is but little. It is barely enough to give a sluggish motion to the cream. Where the difference in gravities is so very small, a slight increase or decrease is sensitively felt, and the careful observer will have no difficulty in noting the retarded ascent of cream in a rising temperature, or its hurried ascent in a falling one. The fact of a hurried rising of cream in a falling temperature of milk has great significance in butter dairying; but, though always open for recognition in every butter-making establishment, whether corporate or private, it has failed of being recognized both by dairymen and dairy writers—perhaps because they have had their minds intently bent on some ideal temperature or depth, as the *sine qua non*.

"A fourth consideration is depth; other circumstances being equal, it must be evident that it will take cream less time to rise through a thin structure of milk than a thick one—less time to rise through three inches than twelve. But depth involves temperature and makes the question of depth a complicated one. It cannot be consistantly considered alone, for there is no particular depth at which, under all circumstances, cream rises better than at every other temperature; and of temperature it may be also said, that there is no particular temperature at which under all circumstances cream rises better than at every other temperature. Depth and temperature are somewhat correlative; in practice they affect each other, and they should be considered in connection.

Further experiments are necessary to note all the facts which result from the combined influence of these two circumstances, but a little explanation may help to show how these general statements are connected with deep and shallow setting. If two vessels of milk at 80° and of the same depth and quality, are set in a room which has an even temperature of 50°—one being cooled to 50° before setting and the other not—the vessel which is cooled will not throw up cream so rapidly nor so perfectly as the one which is not cooled before setting, because the former will receive no benefit from an increased difference between the specific gravities of the milk and cream by reason of a falling temperature. If, after the cooled milk has stood at 50° until the cream ceases to rise, it is warmed and then set again in a room at 50°, or if, without warming, it is set in a colder room, more cream will rise because of the falling temperature that will in either case follow. The same results would be obtained, but in a feebler degree, if the milk which was not cooled before setting were treated in the same way, provided it was set shallow, say two inches deep, in the first place. Milk set shallow in a cold room will not throw up its cream so perfectly as when set in a warm room, because when shallow it drops to the temperature of the room before the cream is all up, and having ceased to derive any benefit from a decreasing temperature, it will not now throw up its cream with sufficient force to bring the heavier particles to the surface. Bearing in mind that the warmer milk is kept, up to a certain point, the sooner it spoils, 65° is a high temperature to set milk in; yet, milk set two inches deep at 65° will throw up its cream quickly and perfectly when it would not do so if set at 50°, because the milk will very soon fall to the standard of the room and cease to derive any advantage from a falling temperature. As cream rises more rapidly in a high temperature than in a low one, it will, at two inches depth, in a temperature of 65°, come up fast enough to rise perfectly before souring begins. If we should set warm milk in vessels six inches deep, in a room at 65°, it would take the cream so much longer to come up through that increased depth, and it would remain warm so much longer that the milk would spoil before it had all risen. But let the deep vessel be placed in a cold room, say 50°, and the result will be altogether different. Unlike the shallow milk in the cool room, the increase of depth and bulk will so much prolong the time of cooling that the cream will all, or very nearly all, rise before the milk has dropped to the temperature of the room. We can now see how the arguments of the advocates of deep and shallow setting are derived. An experimenter having observed a fact like the last, in which the cream is perfectly raised in a deep vessel, declares in favour of deep setting as the best and only sure way to get all the cream; and another one, having set milk two inches deep at 65°, and accomplished the same result, takes position on the other side and becomes an advocate of shallow setting under all circumstances. Each having weighed but half the facts, his arguments cover but half the ground. Had both investigated more thoroughly, they might have been agreed in the position that all the cream can be obtained by either deep or shallow setting, if there is a proper adaptation of conditions; and they might go farther, and lay it down as a rule, that the warmer the room in which the milk is set, the less should be its depth, and the cooler it is, the greater may be the depth. By having the foregoing general statements well grounded in the mind, and keeping in distinct remembrance the relation between temperature and depth, especially the important effect of a falling temperature, any one can, with a little experience, be successful in raising cream perfectly at any temperature from 40° to 70°. It will become clear that, though certain temperatures are desirable, they are not absolutely necessary to obtaining all the cream. There is a great deal of talk about an even temperature for raising cream, and, so far as the dairy room is concerned, it is desirable that it should be uniform, because it gives regularity to all the operations of the dairy and aids in securing uniform results, but so far as the single fact of raising the cream is concerned, it is better that the milk should not be kept at any one particular degree, but at a temperature steadily falling as long as possible. It is an important item in heating milk before setting it, that it gives a wider range of temperature for it to fall through. Low cooling contributes to the same result, at the other end of the scale; but it is necessary to observe that, in using low temperatures, the depth and bulk of milk should be graduated to the warmth, so that the rising of the cream shall not be arrested by too soon bringing the temperature of the milk to a stand-still. If the cooling is sufficiently rapid

to prevent the milk from souring before the cream is all up, the slower the cooling the better, as the benefit of a falling temperature will be more fully availed of. At the beginning, the rapid cooling will throw up cream faster than slow cooling, yet the slow cooling produces the best results in the end.

"The greater the number of degrees of temperature through which milk falls while the cream is rising the more perfectly does it come up, other circumstances being equal. Milk cooled from 80° to 60° in twelve hours will not throw up its cream so rapidly nor so perfectly as when falling from 80° down to 40° in the same time. Facts like this have often been noticed, and a wrong inference drawn from them. It is supposed because cooling to 40°, instead of 60°, makes the most butter, that cream rises better the lower the temperature. But this inference is unwarranted and untrue, for if a mess of milk is divided and one-half cooled to 60° and the other to 40° *before* the cream is allowed to rise, and kept at those temperatures respectively, the cream will rise more rapidly and perfectly on the half cooled only to 60 degrees. This fact may be easily verified by experiment, and the general principle confirmed that cream rises better at high temperatures than at low ones when the *temperature is unvarying*. The other experiment will prove a very satisfactory demonstration of the fact in regard to the influence of raising cream while the temperature is depressing. Particular attention is called to these general facts, because some experimenters who are regarded as authorities, have fallen into the error just alluded to. In effecting a separation between milk and cream, the influence of a falling temperature is so efficient and has been so long and so entirely overlooked, that it deserves a more extended notice than can here be given, but what has been said may be sufficient to direct attention to it. The practices in Sweden and the experiments of Tisserand and others, in cooling to low temperatures, which are just now going the rounds of the agricultural press in this country as evidence that cold favours the rising of cream, are obviously the result of a *falling* temperature rather than a *low* one, *per se*.

"Another important fact that affects the separation of cream, is the growth of minute organic germs in the milk, which, up to a certain point, is greater the higher the temperature.

"There are thousands of germs in all milk exposed to the air, that are ready to start up and grow whenever the milk is warm enough for them to do so, and by their presence, hinder the upward passage of the cream globules. The sour milk cells are the principal obstructions in the way of the rising of cream; they begin to form long before the milk begins to appear thick. The growth of other germs do injury by altering the flavour.

"Organic germs are prevented from interfering with the rising of cream, either by retarding their growth by cooling the milk, or killing them by heating."—*Prof. L. B. Arnold.*

Heating Milk.

"The active agent in the rapid decay of nitrogenous substances, whatever it may be, appears to exist in the air, for if such substances be boiled in water for a time, and afterwards be kept free from the air, they will remain unchanged for a considerable time, but immediately after being re-exposed to the air they commence to decay."—*Sheldon.*

"Above blood-heat milk is not long preserved, unless the temperature is raised to boiling point, and the milk is afterwards kept free from the atmosphere, in which case it will keep sweet a much longer period than if no such precautions were taken."

"Those who make butter from whey often heat the whey to 170°, when the difference in specific gravity between the fat in the cream and the water in the whey is so great that the cream all rises to the top in a short time. By cooling to 60° five or six times as much time is required to effect the same result."—*Arnold.*

"Two methods of raising cream from whey. . . . The yield of butter by the two modes about equal, but butter from the heated whey is the best."—*Arnold.*

"Flecks may be prevented by scalding the milk in which they occur to 130°, to kill the germs which occasion them. When the milk is very much affected a higher heat will be necessary."—*Arnold.*

"They (micrococcus cells) may be killed in milk in the same manner as we scald green fruit."—*Arnold.*

"Heating milk, which is in any degree tainted, to 130° purifies it entirely of all offensive odour, and if at once cooled and made into cheese in the usual way, the product will be the same as from milk not so affected. An ounce of prevention is worth a pound of cure. It is better to avoid tainted milk than to struggle with its effects. But all dairymen have not learned how to do it, and manufacturers must deal with it in the best way they can."—*Arnold.*

"The milk to be made into (skim) cheese is heated to 135° or *above*, while new and warm, and then cooled to about 60° and left for the cream to rise, the same as milk not heated, and skimmed when thirty-six or forty-eight hours old, as is customary in creamery practice."—*Arnold.*

In cases of epizootics "there is a state of uncertainty, which has not been cleared up by any authority on hygiene" as to whether milk at the very outset may have acquired "hurtful properties." "The precaution of boiling the milk should be adopted. Boiling destroys any infective germs that it may contain."—*Dr. Pichon, in Account of Epizootic of 1879-80.*

"Milk, when heated in closed vessels to a temperature of 75° centigrade, remains sweet for ninety-six hours. If the vessel is opened sourness occurs after forty-eight hours. If the milk is heated in the open air it remains sweet only twenty-four hours."—*New York Observer, July 20, 1882.*

"Assumes an etherial form below blood-heat."—*Arnold.*

"They (seeds of fungus plant) grow most efficiently at blood-heat, and nothing short of boiling heat is sure to kill them."—*Arnold.*

"Heating the milk makes the caseine, when coagulated, softer and easier to cure than when not heated; second, it prevents the buttermilk from imparting that peculiar flavour to the cheese which is imparted to it by the buttermilk not so heated, and it promotes as much as other buttermilk the curing of the cheese."—*Arnold.*

"Milk freed from odour by heating a little above blood heat, even after it has been pretty badly tainted, throws up a very nice sweet cream, and makes excellent butter, and milk so heated afterwards makes delicious and pure-flavoured cheese that will keep and hold its flavour as long as milk that has not been tainted. These facts amount to a demonstration, inasmuch as it would be altogether impossible to make a nice-flavoured and long-keeping cheese out of milk that has not been tainted."—*Arnold.*

"Another significant fact is that, after milk has been boiled no odour will accumulate in it when closely covered, showing that the cause of the odour is destroyed by heat."—*Arnold.*

"The conversion of cream into butter is greatly facilitated by scalding the milk or cream while it is sweet. The scalding may be done when the milk is first drawn, or at any time afterward, provided it is not postponed till souring begins."

"Winter churning is often very difficult, and sometimes impossible, without the aid of scalding, and the higher the scalding the easier the cream churns. At other seasons of the year milk, which is for some reason faulty, often has the labour of churning greatly abridged by scalding nearly to a boiling heat."—*Arnold.*

"The plan of scalding the milk soon after drawing from the cow, in order to facilitate the rising of the cream, has been known and practised from time immemorial, in the treatment of late fall and winter milk. The usual method was to set the pans containing the milk in a vessel of hot water on the kitchen stove and when it is heated to the temperature of 130 to 140 degrees Fahr. it is removed to the milk-cellar or the dairy-room and set aside for the cream to rise. Under this treatment the cream comes up speedily and is more easily churned than when the milk is set in the ordinary way. Somewhat recently the plan of heating milk, soon after it is drawn from the cows, to a temperature of from 130 to 140 degrees Fahr., during fall, spring and winter, has been gaining favour with certain fancy butter makers, who speak highly of the practice, and say that the butter from this process meets with ready sales as a fancy product. The heating expels animal odour, to some extent, and in connection with aeration, will, without doubt, improve imperfect milk, or that which is tainted with odours."—*Willard.*

Low-cooling Milk.

In the "Circuit Rider," a tale of the Western States of the "heroic age," Eggleston speaks of "Patty" going down to "strain the milk" in the "moss-covered spring-house." Before her lover came to her on that memorable morning she had filled the second "crock" with milk, "adjusted it to its place in the cold current," and had "neatly covered it with its clean block."

"If a sample of new milk is taken at 65°, and a part of it cooled suddenly to the freezing-point, or near it, and then raised again to 65°, and both parts continued at the same degree, the part which has remained all the time at 65° will keep sweet the longer of the two, showing that dropping the temperature and restoring it has injured its keeping.

"Nearly all the changes in milk and butter, by which they are spoiled, are caused by living agencies, none of which are destroyed by cold, although it may fall below freezing. By chilling milk or butter down below the temperature at which organic change advances, we at least *only suspend advance*, to have it start with renewed vigour whenever the temperature rises to a degree that will allow of its going on again.

"What injures the keeping quality of milk might well be expected to injure the keeping of butter made from it. This conclusion is corroborated by recent observations upon butter made by a refrigerating process, and exposed with other butter during a week of warm weather at a fair. It is also in accordance with observations previously made, and with observations reported by others."—*Arnold.*

"One way (of counteracting taint) is to cool so low as to prevent the action of the ferment by which it is formed. This will stop its increase, but will retard the escape of what is in the milk, and if cooled low enough will condense it into a liquid, and give an animal flavour instead of an animal odour."—*Arnold.*

"By cooling the milk without aërating it the *odour* is converted into a *flavour.* (If the milk is cooled as well as aërated, and again heated up to blood heat, the animal odour is not in it.)"—*Sheldon.*

"Care must be taken not to cool the milk much, if any, below 60° for cheese-making purposes or it is injured. If kept below that temperature milk seems to lose certain properties that it does not afterward regain, the curd from it is dull and spiritless, and the cheese appears to ripen after the manner of fruit in the shade."—*Sheldon.*

"It must, however, be borne in mind that butter made from cream that has been raised in refrigerators will not keep so well as if the cream had been raised at a temperature near to that in which the butter will be afterwards placed. If, for instance, the cream is raised at 45°, and the butter is kept at 55°, decay will sooner set in than if the cream had been raised at 50° to 55°."—*Sheldon.*

"In the ice-water systems *whether the cans be submerged* or *merely set in it to a depth equal to that of the milk, there can hardly be two opinions as to the cream being too thin—that is, having too much of the skim-milk with it.*"—*Sheldon.*

"The cream in the ice-water system does not separate so perfectly from the milk as it does in ordinary shallow-pan setting—probably, in part, on account of the diminished surface of the milk—but it all rises into the upper portion or layer of milk, and remains there intermixed with more or less of the milk; is softer, more liquid, and thinner than cream that has risen in the ordinary way. This appears to be the usual result of deep-setting, whether the milk be cooled in ice-water or not; and there would seem to be little advantage in cooling milk in ice-water in the cold weather of winter. The advantage of such cooling lies in keeping the milk quite free from sourness in the hottest weather. The thinness of the cream in the deep-setting system is by some regarded as a disadvantage, and by others not; these say that it churns the better for being thin, those that it does not."—*Sheldon.*

"And Mr. Hardin says: 'If the milk is set in water,' in open pans, 'and thus kept cooler than the air it, of course, condenses the moisture of the air into the surface of the cream, thus drawing down into the cream all the impurities of the air.'"—*Sheldon.*

"When milk becomes colder than the air in the room in which it stands, as is in the case when cooled with ice or cold water, it tends by its greater coldness, to condense and

take in vapour from the surrounding air, with whatever impurities that air may contain. But when the air is colder than the milk, the air becomes the recipient, and takes up and holds whatever exhalations may arise from the milk, and hence tends to deodorize it. It must be apparent that it would make a wide difference in the quality of butter, whether, while the cream is rising, the milk is cleansing the air, or the air cleansing the milk."—*Arnold.*

"In one factory which we visited, the water had become scanty and warmed up to 60°; in consequence, it required over six hours to reduce the milk to 62°. The butter made after the water failed was the best in the factory, as the manufacturer could readily see when the fact was pointed out."—*Arnold.*

"Packing in brine has one important advantage over packing in ice, as is often done in transporting butter in warm weather. After being packed in ice it perishes rapidly on being exposed to the air, while that in brine keeps all the better for having been in the brine."—*Arnold.*

"Cold checks their growth (of germs), but never kills them. They are not injured at all by freezing and thawing, or wilting and drying. Nothing but heat kills them." —*Arnold.*

Effect of Change of Temperature on Milk and Butter.

"It is believed that it may be safely laid down as a rule that wide and sudden changes in the temperature of butter globules, whether after or before they have been separated from the milk, tend to their destruction. The position here assumed is supported by the nature of butter itself, as well as by observed facts. It is known that the butter globule is an organized structure; small as it may be, each globule is composed of several atoms of fatty matters, differing from each other in their composition, and bound together in one organized body or globule. It is notorious that repeated shrinkage and swelling by change of temperature disintegrates the atoms of these globules, and causes the destruction of the mass of butter which an agglomeration of these globules constitutes. Since a number of changes produce a specific result, it must be evident that each single change has contributed something toward the end accomplished.

"But such changes have less effect while the globules are fresh and new than afterward. A single change made at the most favourable period in the age of the butter globule need not be expected to produce a very strongly marked result.

"There may be other considerations which may make it desirable to heat or cool milk, and suddenly make wide changes in its temperature; but the effect of every such change upon the resulting butter, considered singly, and without reference to other effects, must be to impair its keeping."—*Arnold.*

Even Temperature.

"Keep the temperature of the room as near 58° Fahr. as possible, and guard against the air being dry, by having a small vessel of water upon the stove, or else a dry coat will form on the surface of the cream."—*Lincoln, See Flint, 1860.*

"No one contests the superiority of cream skimmed from milk kept continually at the same temperature, in no way exposed to atmospheric changes, and always cool and sweet. Its products are firmer, more uniform, and generally superior and keep better than the products of milk which has been exposed to changes of temperature."—*Barre.*

Temperature—Medium.

"Any one can, with a little experience, be successful in raising cream perfectly at any temperature from 40° to 70°."—*Arnold.*

"To subject milk to the changes of our variable climate, while the cream is rising, or the butter after it is made, is to spoil the peculiar qualities that constitute it a delicacy that will command a high price."—*Arnold.*

Heating and Cooling.

"The active agent of decay requires moisture, food, and a moderate degree of warmth in order to do its work; a temperature of 212° will destroy this agent, while one of 40° to 45° checks its activity. Hence heating milk up to boiling point, and lowering it to freezing have each the effect of retarding the souring, which is the first stage in decomposition."—*Sheldon.*

"Milk will turn sour most readily at 98°, or blood heat; below or above that temperature the souring is more or less retarded for the time being, according to the extent of the variation."—*Sheldon.*

Souring and Other Changes in Milk.

"Milk, it is well known, is an unstable compound. It is constantly undergoing changes from the time it is formed in the lacteal glands until it is manufactured or consumed. The moment it is secreted by the milk glands, and passed into the tube of the udder, it is attacked by thousands of busy absorbents, that begin at once to suck up and carry away, into the general circulation, the nutrient properties it contains. Milk twelve hours in the udder is a very different thing from milk when first secreted. Exposed to the action of the absorbents that line the milk tubes, it steadily loses, as it passes along, a portion of its fat, its albuminoids, its sugar and water, and, probably, also a portion of its saline ingredients.

"When relieved from the action of absorbents within the udder and brought into contact with the air, other agencies begin at once to act upon it, inducing the changes which afterward occur. Unstable as milk appears to be, it does not perish from anything in the nature of its own elements, but is destroyed by influences foreign to its own necessary composition.

"If milk is drawn from the udder without being exposed to the air and sealed up tight, it neither sours nor taints, provided it is healthy and sound when it is drawn. But if exposed to the air it sours and decays.

"It is what the air contains and not the air itself, that destroys the milk or fruit in this case, for if a long tube filled with cotton be connected with the contents of the can, so that the air which will be admitted to it shall be filtered of whatever foreign matter it may contain, the contents of the can remain sound indefinitely, the same as when perfectly sealed.

"Milk absorbs from the atmosphere the seeds of a fungus plant, which grow and multiply and fill it with their presence, and produce the souring. The seeds of the fungus that are concerned in the process of souring are very small, and are always floating in the air unseen and unsuspected. When developed they are of considerable size, so that they are readily seen with a magnifier of moderate power.

"Cold checks their growth, but never kills them. They are not injured at all by freezing and thawing, or wetting and drying. Nothing but heat kills them. One of these cells, adhering to the sides of a milk pan, or in a crevice, may be dried in the most thorough manner possible, and lie there for a week, a month, or even a year, without injuring it in the least. The moment it is moistened with warm milk, it swells up and springs into active growth, and in a short time its progeny may be counted by the million. Premature souring of the milk is the result. They grow most efficiently at blood heat, and nothing short of boiling heat is sure to kill them.

"A few destructive agencies get into milk through the body of the cow. They are called *Micrococcus* cells. They are exceedingly minute, and everywhere abundant. Their influence tends to produce decomposition. They are also active agents in digestion, and in the coagulation of milk, and in putrefaction. They do no particular injury to milk, unless kept too long, when they produce offensive putrefaction. They are killed with boiling heat. It is to kil! these destructive agents, that we scald green fruit; and we seal it up air tight, while hot, to shut them away from it. They may be killed in milk in the same manner, and if they are effectually shut out by sealing up air tight while hot, milk or sweet cream, as we have found by experience, will keep just as well as canned fruit, and for precisely the same reason.

"There is nothing, therefore, in the necessary composition of milk which makes it sour or putrefy; that it is always matter foreign to itself which destroys it, must be evident from the fact that when all foreign agencies within it are killed by scalding, and those outside of it kept away by excluding the air from it, sweet milk will remain unchanged for time indefinite. Milk which has been thus kept sweet for a year or more, will sour in two days at 60 degrees, by simply letting common air come in contact with it. It is an opinion by no means uncommon among dairymen that milk spoils of its own accord, so to speak, and that it is of necessity short lived. But this, as we see, is an error, and the sooner it is discarded the better. The ready infection it takes from the air in which it may be placed, ought to be better appreciated. If the fact that the short lived tendency of milk was occasioned, not because its composition necessarily impels it to destruction, but simply because it affords such a fertile field for developing and multiplying the minute seeds of fungus plants which are floating in the atmosphere, was more clearly impressed upon the minds of all those who have the care of milk, they would be more cautious than they now seem to be, in regard to the quality of air which they allow to come in contact with it. It requires no long exposure to the air for milk to take an infection that will cause it to sour. A moment's contact is usually enough. The germs of acidity multiply in milk with such astonishing rapidity, that a very few are all that is necessary to set the work a going.

"The influence of the air upon milk is not confined to the absorption of the spores which produce acidity; spores of every other kind are taken in as well. Nor does the absorptive power of milk end with absorbing living germs; it takes in ordours as freely as infectious germs. It is a fact which cannot be too strongly impressed upon the mind of every one connected with the care of milk, or the manufacture of milk products, that milk takes in every odour as well as the seeds of every ferment that blows over its surface.

"This absorbent power is not peculiar to milk alone. It belongs in common to all liquids. Water, placed in a cellar containing decaying vegetation, soon tastes and smells of the decay, and becomes unwholesome to use. But milk, being full of oily matter and holding albuminoids and sugar in solution, offers to ever species of ferment just what is most desirable for it to flourish in. Every odour that comes in contact with milk is grasped and taken in at once, and its grasp is never slackened. Once taken in, it is there permanently, and the seeds of every ferment that touches its surface find such a fertile soil to flourish in that they spring at once into vigorous growth, and multiply and quickly 'leaven the whole lump.' The *London Milk Journal* cites instances where milk that had stood a short time in the presence of persons sick with typhoid fever, or been handled by persons before fully recovered from the smallpox, spread these diseases as effectually as if the persons themselves had been present. Scarlatina, measles and other contagious diseases have been spread in the same way. The peculiar smell of a cellar is indelibly impressed upon all the butter made from the milk standing in it. A few puffs from a pipe or a cigar will scent all the milk in the room, and a smoking lamp will soon do the same. A pail of milk standing ten minutes where it will take the scent of a strong smelling stable, or any other offensive odour, will imbibe a taint that will never leave it. A maker of gilt-edge butter objects to cooling warm milk in the room where his milk stands for the cream to rise, because he says the odour escaping from the new milk, while cooling, is taken in by the other milk, and retained to the injury of his butter. This may seem like descending to little things, but it must be remembered that it is the sum of such little things that determines whether the products of the dairy are to be sold at cost or below, or as a high-priced luxury. If milk is to be converted into an article of the latter class, it must be handled and kept in clean and sweet vessels, and must stand in pure fresh air, such as would be desirable and healthy for people to breathe.

"Many other changes than those enumerated occur in the milk room. The souring process once begun, continues till the sugar is converted into acid. The whey begins to separate from the thickened milk and the vinous fermentation sets in, slowly forming alcohol, which takes up the volatile oils, and the strong acid ferment preys upon the solid fats, to the detriment of the quality and quantity of the butter If still permitted to stand, the alcohol is converted into vinegar, aggravating results. While these changes

are going on, the *micrococcus* cells will be slowly decomposing the cheesy matter, and carrying it on to putrefaction.

"These are some of the changes which are ever progressing under the eye of the dairyman, and he who can most successfully direct and control them is the one who reaps the best reward."—*Prof. L. B. Arnold.*

The Odour of New Milk—"Animal Odour."

"All who have been accustomed to handle or use milk when first drawn from the cow, are aware that it has an odour peculiar to it, at that stage, but which soon passes away if the milk is thinly spread out and exposed to the air. There are many people who cannot use new milk at all till after this peculiar odour has passed off. It is not only disagreeable to some, but produces nausea and other disturbing effects upon health. To others it is not particularly unpleasant, and a few like it. Children often relish milk when new and warm, and it seldom does them any harm on account of its being new, if the milk has come from a healthy animal. But milk is different before and after the smell, peculiar to it when first drawn, has passed off, and its effect as a food is also varied.

"The milk of all mammalia, so far as I am aware, exhibits similar phenomena. The milk of each gives off an odour while new and warm that does not belong to it afterward, and in each case the odour resembles the mingled smell of the breath and insensible perspiration of the animal from which it has been derived. Thus the new milk of the cow smells so much like her insensible perspiration that it is often spoken of as a cowy odour. The milk of the sheep, goat, horse and human, sustain similar relations.

"Previous to the adoption of butter and cheese factories, the apparently evanescent odour of new milk had attracted but little attention. Its existence had simply been recognized, and so far as dairymen were concerned, little else was thought of it. But when it became necessary, or at least convenient, to transport milk to factories in covered vessels, and to move it while fresh and warm, this odour was soon found to be a disturbing element. When milk was put into closely covered vessels, which, on account, of convenience in handling, could not be filled full, and carried a mile or more to the factory, the space in the upper part of the vessels not occupied with milk would invariably be filled with a smell of new milk, which seemed to have accumulated till it became so strong as to be offensive. Upon uncovering the can (the vessel in which it was carried), the offensive accumulation of odour was at once dispersed, and the farmer supposed that to be the end of it; but results in the factory proved differently. It soon became evident that the odour had not departed from it, but had actually increased. When received into the factory, and held in large vats containing several hundred gallons in a body, though exposed to the open air and cooled down to 60 or 70 degrees, it still hung to the milk, and its presence affected the cheese, making it porous and spongy, and giving it a strong flavour. The further fact soon become apparent that it varied in intensity with the varying circumstances which affected the cows. In hot and sultry weather, when the heat of the sun was oppressive and water scarce and poor, and especially when the mercury stood close to 90 in the shade, the odour became intense and offensive, and the effect on the cheese was greatly aggravated. Whenever cheese was made from milk emitting much of this strong smell the curds became soft and spongy, and, instead of shrinking and settling to the bottom of the vat, as usual, they were puffed and swelled, and so much distended with gas as to float on the whey like cork on water.

"By cooling and salting, the curds were worked down to a firmer consistency, but when pressed into cheese the difficulty reappeared. The cheeses would huff up like loaves of bread and be, for a time, about as porous. As soon as they began to cure they gave off offensive gases and soon went to decay. The whey and the curd while it lay in the vat, emitted foul odours which increased in intensity as the work went on. This state of things became quite general, and at times was almost co-extensive with the existence of cheese factories. As the weather became cooler, and water purer and fresher, the milk gradually became better, and the offensive odour died away. This peculiarity in the state of milk comes and goes with every season, and often many times in the same season. Milk of this character is now managed with so much more skill than formerly,

that the disastrous effects upon the cheese are to a large extent avoided. But the fact is now generally recognized by dairymen connected with factories, and especially by manufacturers, that milk fresh from the cow does not make as good cheese as it does after it has stood till the animal odour has escaped, and that, however much the method of working milk, that has from any cause become affected with odour, has been improved, the cheese made from it is never equal in flavour or keeping to that made from milk not so affected.

"The influence of animal odour upon butter is as deleterious as upon cheese. If the odour of new milk is carried into cream and thence worked into butter, as it often is by cooling new milk too low and too suddenly, the butter has a modified flavour in consequence. The fine aromatic and clear and delicious taste of the olein and its essential oils, which are developed in butter from milk free from such odour, are obscured and modified so much as not to be recognized, and a strong and indistinct flavour, as if something foreign and impure had been mingled with the butter, takes the place of the naturally agreeable taste.

"In like manner, butter made from milk which has become affected with odour from a feverish condition of the cows, or from carrying closely covered, takes on an unnatural, strong and unpleasant taste and a greasy appearance, unless the odour is removed before the cream is raised.

"The appearance of these new phenomena in the handling and working of milk, brought into use a new set of terms. As the odour, which had formerly been supposed to belong only to new milk while warm, began to increase from the influence of weather, food, treatment, and the new modes of manipulating milk, and to become intense, it smelled so much like the perspiration and breath of cows as to show an unmistakable animal origin, and hence it has become generally known as 'animal odour,' and this phrase is now in general use among dairymen in the United States, to indicate this peculiar odour of milk in all its stages. When it becomes very intense, it often savours so much of the odours of putrefactive fermentation as to lead to the supposition that actual decomposition of the milk has begun; and hence milk in this advanced stage is said to be tainted, though its condition is in fact quite different from that of other animal matter when we speak of it as tainted. But the apparent analogy of the two cases has brought the phrase 'tainted milk' into extensive and familiar use; and, owing to the fact that curds from this kind of milk usually rise to the surface of the whey, the phrases 'tainted milk,' and 'floating curds,' have become correlative terms, and the latter has had about as wide an application as the former, which is now by common consent used to signify milk from which any strong odour is emitted. The three phrases 'animal odour,' 'tainted milk' and 'floating curds,' have each thus become technical terms and assumed a permanent place in the dairy literature of the country.

"To the outsider it may seem like a waste of words to occupy time in talking about the smell of a thing, but to the American dairyman, the phrase 'animal odour,' is one of dreadful significance. It reminds him of a bitter enemy, one which, however much he may affect to despise, he dare not ignore. It refers him back to losses incurred, which may be estimated by millions, from a perishable inclination and other defects it has given to his cheese. He recognizes in it the most active agent in the destruction of his butter, and oftener than anything else, the cause of that cry which has become to him disheartening and dreadful, from the frequency with which it is applied to his goods, of 'off flavour.' However trifling the odour emanating from milk may seem, it really strikes back to a cause of defect in both butter and cheese, than which none is more potent. If, from ignorance of its power, it has not been appreciated in times past, the introduction of the factory system has revealed its might and made a terrible display of its destructive energy. Dairymen now are aware that there is something in it that needs looking after. It is now beginning to attract the attention it deserves. At the fireside of dairymen, at social knots, at the conventions so often held in the interest of their vocation, 'animal odour' and 'tainted milk,' are never-ending themes of discussion.

"Just what 'animal odour' is, or what it is derived from, has not been well understood either by practical men or scientists, though many have been the speculations in regard to it, and multifarious have been the devices to dispose of it and counteract its effects.

"By some it has been supposed to be the proper and legitimate smell of warm milk. To this it may be objected that the same cow's milk even, does not at all times have the same odour when warm, while, under some circumstances, it disappears entirely while warm, and under others, it increases as the temperature falls. Others have supposed it to be the result of the peculiar warmth of the animal body, and great pains have been taken to get the 'animal heat,' as it is called, out of the milk. This supposition has found a great many adherents, and many cling to it still. A wider mistake could hardly have been made, nor a more baseless theory be imagined.

"In the first place there is no difference between animal heat and any other. All heat, whether generated in the animal body or out of it, is the same. There is but one kind of heat, from whatever source derived. This fact is too well known to need demonstration.

"In the second place, heat and odour are entirely distinct from each other. The former is only a condition of a thing, while the latter is a thing of itself—a substance it must be, to be appreciated. How idle then to suppose that warmth generated in the body of a cow should give rise to any particular kind of odour. Yet the number of dairymen who still persist in using 'animal heat' and 'animal odour' as synonymous terms, or in considering the former as the cause of the latter, is legion.

"A simple experiment will illustrate how untenable both of the preceding suppositions are. Upon an occasion, which accidentally occurred, when my cows where giving milk strong with animal odour, I made a small filter containing pulverized charcoal and passed the milk through it as soon as drawn. Upon emerging from the filter at a temperature of 90 degrees, it was perfectly delicious, both in taste and smell. Though retaining nearly all its animal heat, it had lost all its animal odour. By continuing the use of the filter, the coal soon became saturated with the odour, giving unmistakable evidences of its presence, and showing that animal odour, or the odour peculiar to new milk, does not belong to the milk itself, since it can be separated from it, leaving the milk free from any such smell—the milk in the meantime being unchanged.

"In attempting to account for the strong odour which occurs in hot sultry weather, it has been assumed by some, that a putrefactive change begins in the milk the moment it is discharged from the udder, and in some cases, even before it leaves that organ. If this supposition were true, ammonia or nitrogen, in some form, should be given off. But tests have shown that no nitrogen escapes in any form, either combined or free, from what is known as tainted milk. The discharges have been carbonic acid gas mingled with the peculiar odour.

"That no change of the character supposed occurs in milk under the circumstances described, is evident from the fact that milk freed from odour by heating a little above blood heat, even after it has been pretty badly tainted, throws up a very nice sweet cream and makes excellent butter, and the further fact that such milk so heated afterwards makes delicious and pure flavoured cheese that will keep and hold its flavour as long as milk that has not been tainted. These facts amount to a demonstration, inasmuch as it would be altogether impossible to make a nice flavoured and long keeping cheese out of milk in a state of actual putrefaction. Hence it becomes necessary to look for the basis of animal odour in some other direction.

"Having observed that this peculiar odour escapes more rapidly as the temperature rises, and more slowly as it falls, till ceasing to escape at all, it remains permanently in the milk, the writer at first regarded it as a gas emanating from the waste matter of the body, especially, as under different circumstances its odour corresponded to that of excretory matter. At low temperatures, it appeared to assume a liquid form, for though it ceased to give off any odour, its presence was made manifest by a flavour corresponding to the odour.

"Prof. Caldwell of Cornell University, suggested that its behaviour was that of a very volatile oil, rather than of a gas.

"To test this suggestion, a sample of milk in which odour had purposely been allowed to accumulate was distilled and a small quantity of a clear limpid oil, with a slightly yellow tinge, was obtained. At 35 degrees (F.) it was as fluid as water and emitted no odour, but

upon warming a little, it quickly assumed an aeriform condition and disappeared with an intense smell of new milk—the genuine animal odour.

"A few experiments demonstrating that the odour in question is an extremely volatile oil, the next query was, how does the oil get into the milk? If the odour disappeared upon cooling and exposing to the air, and never reappeared, the inference would be that it was a secretion of the milk glands, the same as the fatty matters in butter. The investigator might at least be satisfied with referring it to such an origin. But the formation of the oil does not stop with the discharge of the milk from the udder. It continues to form out of the udder the same as in it, if the milk is kept warm. As the temperature of the milk falls, it forms more and more slowly till it ceases entirely. It only fails to become intense because being open to the air it escapes. Cover milk closely and keep it warm, and the odour will soon become as strong and even stronger than in new milk. Nor is its formation confined to the udder or the milk. The same odour appears to be all the time escaping in all the excretions of the body—the breath, the liquid and solid fæces, and profusely in the perspiration. The odours in these different cases vary a little from that in new milk as well as from each other, and the odour from milk in different circumstances differs in the same way. The milk of a cow smells differently when she is quiet from what it does when she is worried; differently when she is feverish from what it does when she is not; and odour formed in the udder is different from that formed out of the udder when the milk is closely covered; yet its general characteristics are so analagous as to be unmistakably the same thing. The samples of oil obtained by distilling milk under these different circumstances cannot, while liquid, be distinguished from each other, and they all alike fly off in vapour upon being warmed, but in taking on an ethereal condition each gives off exactly the same odour as the milk it was derived from.

"Again, the milk of a single cow, if feverish, would soon bring a 600-gallon vat full of good milk into the same condition as itself, if it is kept warm. The milk of a half-dozen or more feverish cows would, to be sure, do it sooner than one. But the fact that a small mess of milk tainted with any modification of animal odour will infect a large mass, is a fact well known and is a point to be noted. Another significant fact is, that after milk has been boiled, no odour will accumulate in it when closely covered, showing that the cause of the odour is destroyed by heat.

"Since the oil on which animal odour depends multiplies independently of the animal body, being formed in milk as well after as before it leaves the udder; since its formation increases and diminishes with the rise and fall of the temperature of milk, till the ultimate cause is quieted with cold or removed with heat; and since a small mess of affected milk spreads its peculiar characteristics through a large mass with great rapidity, obeying all the laws of a ferment, it is deemed a safe conclusion to infer that the peculiar odour of new milk, and what is generally known among dairymen as animal odour and taint in milk, are produced by a volatile oil formed in the milk by the action of a peculiar yeast, which is present in a greater or less degree according to the circumstances under which it is produced. As in other cases of fermentation, the yeast or ferment, which is the active cause of change and new products, has been found to consist of living organic germs; so in this case, it may fairly be inferred, from the close analogy in action and results, that the growth and multiplication of organic germs are the cause from which the peculiar odours of milk are derived.

"The circumstances which contribute to an increase of odour in milk, before it is drawn, are very numerous. They are in general such as disturb the health or heat the blood of the cow, and these disturbances may consist of mental as well as physical treatment. The following may be specified as among the most common causes: Oppressive heat of the sun—especially in sultry weather, and when scanty feed occasions too much exposure of the cows to fill themselves. Taint in milk is very apt to increase and diminish with the rise and fall of mercury in the thermometer—a circumstance which shows that in this latitude cows need protection from the hot sun in summer as well as from the cold winds in winter. Stagnant water—this is a very prominent and efficient cause in producing an increase of odour. Scarcity of water—when cows lack a full supply of water, or when it is not convenient of access, the odour of milk is very soon

affected. So also with dogging cows, driving fast, or too long journeys, or in any way worrying them. A slow pace and short journeys for cows in hot weather are required for good milk. Worrying or in any way heating the blood, violent usage, pain, uneasiness, fright, solicitude, sore teats, garget, cow-pox, being in heat, any disease, and especially such as produces feverishness; breathing bad air, as the odour from carrion or the air of foul and close stables, or of a filthy barn yard; gorging, as when cows break into forbidden enclosures or are fed with more food of any kind than they can digest; feeding improper food, or food in a state of decay or highly fermented, as the refuse of the dai in a stale condition; the slops of the distillery and brewery; decayed grass which has lain on the ground during the winter; coarse and sour grass, grown on swampy places or in low moist ground; rank green clover in the early stages of its growth; eating strong scented or medicinal food; going too long without milking; suddenly checking perspiration by exposure to cold or wet.

"The principal causes which produce bad odours in milk, before it is taken from the cow, and which afterwards become the cause of taint, are oppressive heat and stagnant water.

"Of the causes which increase the odour in milk after it is drawn, the principal one is keeping the warm milk closely covered, so that the odour which was in it when it was drawn, and that which afterward forms, cannot escape.

"Another very efficient cause is defective cleansing of dairy utensils. Another, cooling too rapidly, or not soon enough, or not low enough; exposing the cans containing milk to the hot sun while in transit; exposing milk to foul odours at the farm-yard and at the factory; keeping milk in large masses without sufficient stirring, and various other similar defects in the care of milk, contribute to augment the development of odour. Though it is no easy task to keep clear of all these causes of injury, it is necessary to do so in order to have perfect milk.

"Again, when dairymen appreciate that the cause of the odoriferous oil in milk is a ferment, it will be as easily wiped out as the oil itself. The laws which control the propagation and destruction of ferments are well known. They originate from seeds as distinct as the seeds of grain, and are like them in some respects, but more than equal them in tenacity of life. The seeds of the cereals retain their vitality under great exposure and severe treatment while they remain dry seeds; but the moment they germinate, they are easily perilled; their strong hold on life is gone. A little exposure to heat or cold, wet or drought, or to a little violence, and they become extinct at once. So with the seeds of ferments, while they remain spores they retain their vitality under almost any vicissitude, but the moment they become developed into growing fungi, their destruction, like that of sprouted grain, is very easy. Though they require oxygen in the composition of their food, they cannot endure it on their surfaces. Though they require warmth to develop, they can bear but a certain amount of it. The ferments which flourish so luxuriantly in milk can only do so when protected from the attack of oxygen by a liquid envelope. The mushrooms that spring up under cover of the dark and dampness of night to wilt before the light and dryer atmosphere of day, are more tenacious of life than the germs which constitute the ferments in milk; they perish instanter when exposed to a little too much heat, or to the corroding influence of the oxygen in the air.

"One of the most effectual barriers now in the way of further improvement in factory cheese making, lies in carrying milk warm and closely confined to the factory. The objectionable odour is developed in the journey to the factory. Milk, in which a strong taint is liable to develop, appears, when first drawn, scarcely different from sound milk. It would be difficult to distinguish them, yet when it arrives at the factory the affected milk is so full of odour as to become offensive. To avoid this increase of odour on its way to the factory, is the next important point, next to avoiding the original cause in the care of the cow. Having discovered that the odour is simply a very volatile oil that is all the time forming and escaping at common temperatures, three ways of counteracting it suggest themselves. One is to cool so low as to prevent the action of the ferment by which it is formed. This will stop its increase, but it will retard the escape of what is already in the milk, and if cooled low enough will condense it into a liquid, and give

animal flavour instead of an animal odour. A second way is to give it a free chance for escaping. It will then pass away without help as it is formed, leaving the milk in its original purity. A third way is to hurry its exit by heating, and if occasion requires raising the heat so high as to destroy the ferment and remove the cause entirely.

"In discussing the subject of the so-called animal odour in milk, it has been deemed appropriate to speak thus fully—first, because the investigations in regard to its nature and origin will be new to many readers; second, because the multiplicity of views in regard to it among dairymen seems to demand a definite solution and explanation so clear and full that it could be understood and appreciated by all; and thirdly, because the important part it plays in modifying the quality of butter and cheese, require that it should, if possible, be well enough known to be controlled and counteracted."—*Prof. L. B. Arnold.*

Aëration.

"A second way (of counteracting taint) is to give it a free chance to escape. It will then pass away without help as it is formed, leaving the milk in its original purity."—*Arnold.*

"The sickly and nauseating flavour and odour are to a great extent dispersed by simply aërating the milk without cooling it at all; and if the milk is cooled as well, and again heated up to blood heat, the animal odour is not in it. By cooling the milk without aërating it the *odour* is converted into a *flavour*, either aërating or heating for 110° will expel the odour."—*Sheldon.*

"If the milk (closed in creamers) were first of all aërated by forcing through it a volume of air which had been filtered through cotton-wool, or in some other effectual manner, we think this system of milk setting would be as nearly as possible perfect. It may be here remarked that aëration is the more effectively done if a gentle wind blows away the gases as they escape from the milk."—*Sheldon.*

"The active agent in the rapid decay of nitrogenous substances, whatever it may be, appears to exist in the air."

"The souring of milk is a fermentative process, the active principle of which consists of living organisms, most of which belong to the vegetable world. The germs or fungi, from which these organisms are developed are commonly derived from atmospheric dust which is deposited on substances exposed to it."—*Sheldon.*

"Milk will remain sweet all the longer if a current of pure atmospheric air or oxygen is forced through it previous to cooling. An exposure to pure air supplies the requisite oxygen, and admits of the escape of the gases and odours which, common to milk that is freshly drawn, are, in themselves, elements of decay."—*Sheldon.*

"It must not, however, be aërated in an atmosphere reeking with the odours of the cow shed, etc."—*Sheldon.*

Cream Rising.

"The movement of the cream globules is caused by gravitation, and they rise in the milk just as a balloon rises in the atmosphere. Cream is very little lighter than the rest of the milk, and when the whole is of an equalized temperature the cream rises very slowly. It rises best in a falling temperature; this is because the water and caseine of the milk are better conductors of heat (and cold) than the cream globules are. The former therefore cool faster than the cream, and the weight consequently increases causing the cream to rise faster. The larger globules rise to the surface first, the next in size follow, the very smallest coming up last. In some milk there are globules so small that they never rise."—*Arnold.*

When to Skim.

"The cream should be taken as soon as the first acid is perceptible if it be desired to make sour-cream butter, while if it be desired to make sweet-cream butter it must be done before any acid is developed. I do not allow the cream to stand any length of time after the milk is acid, for the reason that it does not increase the quantity of cream."—*Lewis, 1883.*

"The milk should be skimmed when the cream has all risen, and before the milk has thickened. The exact time required for it to rise will, of course, depend on the temperature, but a little experience will enable one to tell.

"At the time the cream should be removed, it will be of a rich bright yellow, and of such consistency that it can be removed almost entirely from the pan without breaking.

"If allowed to stand too long without skimming, both the quantity and quality of the cream will be seriously affected; it will not churn so quickly, nor make such good butter, nor will the butter keep well. Indeed, this is one of the principal reasons why there is so much rancid butter in the country. Yet in order to make the largest quantity of butter, care must be taken not to skim too soon, for then the full cream would not be got from the milk, which would involve considerable loss."—*Prize Essay, Ingersoll, 1883.*

Cream Ripening.

"If the quantity of cream was insufficient for one churning, I would set it in a tin-pail until I had enough, adding say a large spoonful of salt with the first skimming, and stirring it thoroughly, and so with each subsequent skimming until there would be enough for churning. I believe the best time for churning the cream is when the last cream has been added twelve hours."—*Lewis, 1883.*

Moderate Souring.

"It is obvious that incipient decomposition, which is but another term for ripening, develops the flavours we so much admire; and it is equally obvious that these pleasant flavours become unpleasant after a time, as decomposition proceeds. Thus it follows that a given degree of acidity is useful in both cheese and butter-making, developing as it does the flavour and aroma."—*Willard.*

"In small dairies, sweet cream butter is out of the question. Whoever should recommend it ought to be condemned to do the churning. We believe he would then be satisfied to pay one dollar a pound for it rather than churn it himself. We would suggest churning sweet cream as a capital punishment for criminals condemned to hard labour, but for nobody else. Our practice, and that of many good butter-makers, is to cream when the milk begins to sour, stirring the evening's along with the morning's cream, and churning next day. In the fall or winter, when we have not enough to make a churning so frequently, a little salt is put in the first creaming, and at each skimming stirred all together."—*John Smith, Ingersoll, 1883.*

Cream—Keeping It.

"Cream should, in *usual* cases, be kept in what may be called the normal temperature for butter-making, or 60°. If, however, it may be necessary to keep it an unusually long time, the lesser of two evils would be to keep it at an unusually low temperature. If, on the other hand, it be required to hasten the process of ripening, it may be done by heating up the cream to 70°, or above, and only cooling it just before churning."—*W. H. Lynch, in Canadian Farmer.*

CHURNING.

The main essentials in churning are: first, to churn so as to break as little as possible or not at all, by the action of the churn, the butter globules; second, to cause the cream to break into butter simultaneously, or as nearly so as possible.

1. Not to break the butter globules. There is no necessity for a churn that works upon the principle of a threshing machine. A regular uniform action will be sufficient that will keep the cream in constant motion, bringing all the globules in turn to the air. It is enough when the sacks of the cream globules are burst, and the grain of butter is free. More than this is only damaging to the grains of butter, too much whipping injuring the flavour, the colour, and the general qualities of the butter.

2. To bring the whole butter as nearly as possible at one time. If it be an object to grade the cream with a view to accomplish this result, it is equally an object to make use of a churn that will have the nearest to the same effect. Both objects seek that "none of the butter be over-churned, and that all may be of the very best quality." If the cream can be graded and the churn be adapted to work out the butter, as it were, *simultaneously*, then we have as a result a high grade of butter, something that will be nearly perfect in texture and full-flavoured. If the cream has not been graded all the more need of churning in a way to approximate to the desired standard of quality, and give something above the average. That there is a difference in churns all butter-makers well know. In the *dasher* churns some of the cream is continually lodging in places where it does not bear with the rest the action of the churn. Leave it there and it is wasted, scrape it down into the general mass and you have a mixture of cream in different stages of progress towards butter. The simpler the construction of the churn and the less complicated, so that the whole volume of cream will remain and agitate together, the better adapted is the churn to this important end sought.

Preparing Cream for Churn

"When cream is too cold, I would set the cream-holder in a tub, surround with warm water, and stir until the proper temperature was obtained; and if it were too warm I would surround with cold water, and thus reduce it to the proper state."—*Lewis, 1883.*

"In warm weather the cream should be a little under, and in cold, a little over 60 deg. for churning. The crock or pail may be set in hot or cold water to bring it to the proper temperature; but no water, either hot or cold, should now be added to the cream."—*John Smith, Ingersoll, 1883.*

Thinning Cream.

"If the cream were too thick I would thin it to the proper consistency with milk, but I would never add water until after granulation (in churning)."—*Lewis, 1883.*

Adding Water.

The practice of a successful dairyman of New York, quoted by Mr. Flint, was to put "from one to two pails of water in each churn."—*1860.*

Preparing Churn.

"Previous to churning, the churn should be scalded out and then rinsed with cold water to the temperature of the cream.'

Temperature in Churning.

How little have we learned in some respects that is new. Said Mr. Lincoln, years ago: "The regulation of the temperature is of the greatest importance, for should it be too low, you will be a long time churning, and have poor, tasteless butter; if too high, the butter will be soft and white."—*Flint, 1860.*

This can be true of the low temperature, only when it is very low, or much lower than is likely to be the practice of many butter-makers.

"If the cream has been raised by the cold process the setting temperature for churning might be 65°, without detriment to the butter, while if it has been raised at a temperature above 60°, I would reduce to 58° for churning."—*Lewis, 1883.*

Temperature Changing while Churning.

"If you are churning in a cold room, or if it lasts very long, the temperature of the cream may drop a degree or two; and if churning in a warm room it may raise a little, and it is well to guard against this."—*Lewis, 1883.*

Motion in Churning.

"Not so much for the kind of churn, but whether you take the 'dasher,' the box, or the barrel, you can work them so as to get friction on the cream. You must work it with a proper motion so as to give cream the greatest amount of concussion with the least friction."—*Lewis, 1883.*

There is, of course, more danger of too much concussion in the churn which brings butter in a few minutes, than in the box or barrel, which works more slowly.

Churning—Time of.

"Supposing the cream to be at the proper temperature, 58 degrees, the churning ought not to take more than twenty-five minutes in summer, and thirty-five to forty-five in winter."—*Continental Dairying.*

How strange we are so long learning some things. Before half the churns for churning in five minutes were invented, competent authority said they were unnecessary: "Various contrivances have been made to shorten this operation; but the opinions of the best and most successful dairymen concur that it cannot be too much hastened without injuring the fine quality and consistency of the butter. The time required depends much on the temperature of the cream, and this can be regulated at convenience."—*Flint, 1860.*

Fast Churning.

"The time has been when it was thought a merit to eat fast. The rebuke that Abernethy gave to the Honourable Alden Gobble, Secretary of the American Legation at the Court of St. James, is, perhaps, needed by many who believe in economy to save time in eating. Gobble was a dyspeptic. Abernethy told him he would soon get rid of his dyspepsia, for in the company he was now thrown he would have to eat like a Christian. Upon being contradicted, the old eccentric aroused, gave his opinion, and with characteristic roughness: 'I never saw a Yankee that didn't bolt his food whole like a boa-constrictor. How can you expect to digest food that you never take the trouble to dissect nor time to masticate? It's no wonder you lose your teeth, for you never use them; nor your digestion, for you overload it; nor your saliva, for you expend it upon the carpets. You Yankees load your stomachs as a Devonshire man does his cart—as fast as he can pitch it with a fork, and as full as it can hold, and drive off. Then you complain that such a load is too heavy for you!' And so it is with churning. It was once thought an object to churn fast; but that time too is gone by. True, there are farmers yet who need a little advice from some agricultural Dr. Abernethy. On looking at a churn their first enquiry will be: 'How long does it take to bring the butter?' But they are few. The days of three-minute churning, by thrashing the cream, has gone the way of five-minute dining, by bolting the food. The best dairymen now will have nothing to do with a churn that is constructed mainly with a view to *quick* work. They do not appreciate the ingenuity of giving them mechanical appliances that will hasten the operation of churning at the expense of *quality* or product. What they better appreciate now is something simple as possible in construction, and constructed mainly with a view to do *good* work. On the other hand they require that a churn do its work in a reasonable time, as now understood, and that what it loses in the once supposed merit of *speedy* churning, be made up by the always undoubted merit of *easy* working.

"Mr. Flint quotes the practice of a successful New York dairyman, who churns from one hour to one and a half. This in a book published twenty years since. Even at that time, he remarks, the time of churning is by no means an unimportant matter. Various contrivances have been made to shorten this operation; but the opinions of the best and most successful dairymen concur that it cannot be *too much* hastened without injury to the fine quality and consistency of the butter. Italics ours.

"Says Prof. Miller (1872): 'One often hears of churns in which it is claimed that butter will come in three minutes. I have yet to be convinced that good butter may be got from the cream in that time. That cream can be churned into good butter in three

minutes I am aware, and although the butter may be tolerable for present use, I have never been able to get a good keepable article when the churning was done in such a short space of time. The butter globules are enclosed or surrounded by thin pellicles of caseine. In churning these are broken and separated from the oily particles. If the churning is done rapidly the separation is imperfect, and hence we get an article of butter in which there is too large a proportion of the shells of caseine. It is the caseine and nitrogenized constituent of milk that is liable to decomposition and which injures the flavour of butter.' Voelcker is here quoted as saying that pure fat or oil is easily kept sweet, and if all the shells of caseine could be separated from the butter it could be preserved readily without salt.

"Prof. Johnson, of Yale College (1868), said: 'When butter has to come in a few minutes by violent agitation, as in the trial for the repute of quick work in cases of trials of new churns, there is churned instead of good butter in dense and large clumps, a doughy mass, consisting of little balls of fat mixed with buttermilk and cream, and full of air bubbles, which no skill in working can convert into good butter. While it is true that violent churning will produce a greater weight of so-called butter, it is demonstrated by chemical analysis that the milk or cream thus treated does not yield so much of its fat as is obtained by slower and gentler agitation. The greatest weight of product is due to the admixture of buttermilk which is retained in the spongy mass.'

"The Orange County butter-makers say that the time should be from forty-five minutes to one hour. Prof. Johnson says half an hour at least is considered essential for churning, when the volume of cream is considerable; and an hour, or even more, is not thought too much.

"Mr. Flint says that the time required depends much on the temperature of the cream. We may add that it depends too on the cream itself, and also upon the churn. Other things being equal, one churn may do the work more quickly than another churn, and give as good quality. A good churn ought to take good cream at a right temperature, and, unless it is peculiarly hard to churn, bring butter in less than one hour. There may be churning too long, even as there is churning too fast. Where churning has been too quickly done, it has usually been by working the cream upon wrong principles. Where it has been considered necessary to have the time of churning long, it has usually been because the churn used has not been perfected to the highest degree possible. For instance, two churns may be constructed generally upon correct principles, and alike so far as the motion of the cream is affected, and differ in the one respect of air circulation. Other things being equal, it cannot be doubted that the churn which the more freely admits the fresh air, and allows the gas generated by motion the more readily to escape, will give the same quality of butter in a shorter time.

"A good rule then is this: Do not churn too quickly, but aim to bring the butter as soon as it will come consistent with well-known principles of butter-making."—*W. H. Lynch in Charlottetown (P. E. I.) Examiner.*

Saving the Grain.

"The object of churning is to divest the milk globules of their delicate membraneous covering without breaking or disturbing the granules of fat within them. This is best done by a force in which *motion* and *pressure* are combined. Such a power is better than *motion* and friction. Repeated impulses of motion and pressure act upon the entire mass at once and alike. Motion and friction act only upon such particles as the instrument used comes into contact with. Friction wears off the pellicles and does its work unevenly. The larger globules meet with the most friction, and hence their pellicles are worn off first. These gather into lumps before the smaller ones become churned. If the churning continues till the smaller ones 'come,' the larger ones become over churned and greasy by the excessive friction. Pressure operates upon large and small nearly alike, and the globules of different sizes come nearer together and more perfectly, producing more and better butter."—*Arnold.*

"If butter, either in churning or making, is treated with so much violence as to break the grain and make it greasy, it will go to decay, like bruised fruit and broken

eggs, and for similar reasons. Greasy butter is so perishable that there is no use in packing it away for a future day. It will depreciate from the start, and fail continually. Salt will not save it. Many people have an idea that salting high will save butter. No mistake could be greater. It is the avoidance of injury in making which gives to butter its best keeping quality. Butter not injured in manufacturing is the only butter that will keep. Faulty butter will 'go marching on' to destruction, though buried in the best of salt."—*Prof. Arnold.*

Colouring.

"There are certain seasons in the year when the cows fail to give butter the proper colour. Every man who consumes butter would rather have his butter yellow. This is a universal preference. Very few men would believe that gold is gold unless it is yellow, and you can hardly make a man believe that butter is butter unless it is yellow.

"The addition of a little colour gives butter a nice appearance, and there are many preparations which are harmless."—*Lewis, 1883.*

"Mr. Belknap, of Boston, considers artificial colouring a commercial necessity in these times."—*Prof. Wetherell.*

"I do not believe in the use of any artificial colouring, and never considered it necessary, as we can always get a good, rich colour without any adulteration."—*McNamee, Brockville, 1883.*

Removing Buttermilk when Butter is Granulated.

The process of freeing butter from buttermilk while the butter is yet in small grains is advocated here as against the more common way of churning till the butter has completely gathered in one lump. An attempt has been made in the main part of the *Manual* to show the great advantage of the new process over the old way. The importance of the change advocated warrants large space in this *Appendix* being given to the matter. Even those who have adapted the new process do not all fully appreciate its advantages; it is too much to expect that others to whom it is quite new will quite appreciate it. To emphasize this importance, the practices of those who have adopted the improved method will be given at some length. This will show partially the stages of the change, but principally the fact that the process is an especial characteristic of the advanced butter-maker, and consequently has practical as well as theoretical claims to belong to the "scientific" method of butter-making.

The essential feature in the process is the stopping of the churn at the right time, so as to take away the buttermilk as early in the process and as quickly as possible. One of the first American butter-makers to follow out the practice so far as recorded, is Mr. Lincoln, the Massachusetts premium butter-maker. Mr. Flint quotes him as saying:—"When the butter has *come*, the buttermilk is drawn off, etc."

Mr. Flint next quotes the Philadelphia butter-maker, whose product had already a high reputation:—"After the butter has made its appearance of the size of a small pea, draw off the milk, and throw in a small amount of cold water and gather it."—*Flint, 1860.*

This is but the beginning of the change, and incomplete. From recent works on butter-making, and from articles in the agricultural press on the subject, the new process takes prominence. Agricultural papers give in nearly every issue reference to the practice of some one of the comparatively few successful butter-makers which is characterized by this system of "gathering butter." The ways of arriving at the result are many and various, but all aim at one thing, to remove the butter-milk at as early a stage in the operation as possible. I shall give a few examples:—

"A careful enquiry into the manner in which butter is made in the several districts of Normandy has convinced me that, other things being equal, the quality of the butter depends upon the *earlier or later period at which the washing is commenced.*"—*H. M. Jenkins.*

"Stop the churn as soon as the butter becomes the size of a kernel of wheat, draw off the butter-milk and wash the butter with cold, iced brine."—*Mr. Bowditch.*

"As soon as the butter will permit, and while it is yet in fine grains, the buttermilk is drawn from the churn and cold brine poured over the butter to wash it."—*Miss Morley.*

"It is important that as much as possible of the caseine should be washed out, so that the butter will keep good the longer. Caseine decomposes much earlier than fat, and much butter comes to an untimely end on this account."—*Prof. Sheldon.*

"The moment the butter comes in small granules, like pin-heads, the churning ought to be stopped; any revolutions after that is destroying the fine grain of the butter, and gathering in it the very substance, "buttermilk," which must be entirely got rid of. We are convinced that a large quantity of butter made in Ireland may be attributed to over-churning. In Denmark, the dairymaid most carefully watches the formation of butter by examination of the spigot. In Normandy it is known by sound when the butter is formed; in both cases they pay the most particular attention, and lay great stress upon this point. Supposing a barrel churn to be used, when the butter is formed in fine granules, strain off the buttermilk through a hair sieve, rinse out the churn with spring water, give the churn a few revolutions, strain off again, repeating the operation until the water comes as clear and bright as when it is put in. When the barrel churn is not used, either the hand, or what is far better, the butter-worker must be used to press out the buttermilk."—*Continental Dairying.*

"When the butter shows signs of coming—when you can see the little granules of butter forming—I believe it is the best practice to reduce the temperature to about 55°, which can be done by cold water, *but never ice*; then I would continue churning until the butter granulated about the size of wheat; I would add some more water, and turn the contents of the churn into a fine sieve, and allow the buttermilk to run off; then rinse and by means of the butter ladle, place it on the butter-worker."—*Lewis.*

"By this method the butter is more perfectly, and at the same time more easily washed than it can be by any other means, nearly all the caseine is removed, and the grain of the butter is not at all injured. The butter may also be salted in this way, if we put in brine instead of water the last time or two, and the churn itself may be afterwards perfectly washed by putting boiling water into it, once or twice repeated, after the butter is all taken out, and by turning the churn a few moments vigorously."—*Sheldon.*

"The churning occupies about an hour, and after the buttermilk is drawn off cold water is added and a few turns given the churn, and the water then drawn off. This is repeated until the water as it is drawn off is nearly free from milkiness. The butter is worked with butter-workers, a dampened cloth meanwhile being pressed upon it to absorb the moisture and free it of buttermilk. The cloth is frequently dipped in cold water and wrung dry during the process of wiping the butter."—*Willard.*

Washing Butter.

There is no question as to the merit of the plan of taking the butter from the churn in its *granulated* form. All advanced butter-makers are in favour of the mode, it matters not if the further practice is to wash or *knead* the butter. But upon this further process of separating the buttermilk from the butter there is a difference of opinion. The writer has taken the position that washing is the better process, providing always that the water is of sufficient purity to make the process what it ought to be. The weight of the evidence of successful practice is with the position taken.

"It is is generally customary to collect the butter into a solid mass before leaving the churn—to "gather" it. This is best done by cooling the contents of the churn gradually, as the butter begins to come or show signs of coming, and operating the churn slowly. Butter gathered in the churn always contains more or less buttermilk, which would soon spoil the butter if not removed. There are two ways of removing it; one is by kneading it in water or brine, and the other by kneading it without water, etc., etc."—*Arnold.*

"The cream should be churned at least once a week; the butter should then be thoroughly washed by churning it in cold water—an operation that should be several times repeated. This process is necessary to free the butter from the buttermilk, for if any remains the caseine and sugar contained in it are subject to decomposition, the former becomes rancid, and the latter is converted into ascetic acid, and thus the butter becomes a poor sort of grease."—*Rural.*

"The reason why the dairyman washes butter is to remove all foreign matter and retain all the butter with its aroma unaffected. When the buttermilk is drawn off and the butter left in the churn, the latter is still surrounded with many impurities, of which particles of buttermilk are the most numerous, also particles of caseine or cheesy matter. This latter matter is more liable to spoil or become tainted than the butter itself.

"Butter becomes rancid through the action of the oxygen of the atmosphere, but caseine becomes putrid; the latter is being rapidly produced while the rancidity of the butter is much slower in development.

"One of the important problems of the dairy is whether or not these impurities—viz., buttermilk and caseine—can best be removed by washing with water. There is no doubt that the buttermilk can be all worked out, but caseine cannot be so disposed of, since it adheres to the butter, and can only be removed by water. The best method of removal is as follows:—

"Before making any attempt to gather the butter, and while it is yet in its granulated state, or rather in separate particles, say about the size of a pea, the buttermilk should be drawn off, and a quantity of pure, clean water thrown into the churn; then agitate the butter with the water in the churn, draw off the water, then add more water; agitate again, and finally draw off all the water, provided the latter is not milky in appearance. In other words, continue to add fresh supplies of clear water, and continue the agitation and the drawing off of the milky water until the water is perfectly clear after the agitation; then the washing has had its proper effect.

"The butter will now require little working, and the grain is not likely to be broken; but if the buttermilk is to be worked out, and with it the caseine, it is very likely that the grain of the butter will be broken, and the product will have a salvy appearance, which, when cut with a knife, instead of having a bright, shining appearance, will appear dull as lard.

"Those who contend for working the butter in place of washing, urge, as one reason, that the aroma is washed out, and that the colouring of the butter is removed. This is not so, since the water removes the impurities of the butter by its mechanical action, and not by its solubility.

"There is no doubt, if butter be kept for a length of time in water, its colour and aroma would be removed, but that is not the case in simple washing, and the butter is not soaked. In the operation nothing is taken from the butter that it would be desirable to retain.

"Washing butter, in its effect, may be compared with the rinsing of clothes in the washtub. Much labour is saved in the washing of butter over the working of the product; and besides, through the former process the keeping qualities of the butter are best secured."—*Fashion Paper.*

"The difference between washed and unwashed butter is analagous to the difference between clarified and unclarified sugar. The former consists of pure saccharine matter, while the latter, though less sweet, has a flavour in addition to that of the pure sugar. When unwashed there is always a little buttermilk adhering to the butter that gives it a peculiar flavour in addition to that of pure butter, which many people like when it is new. Washing removes all this foreign matter, and leaves only the taste of the butter, pure and simple. Those who prefer the taste of the butter to that of the former ingredients mixed with it, like the washed butter best. The flavour of butter consists of fatty matters, which do not combine with water at at all, and therefore cannot be washed away by it. The effect of washing upon the keeping qualities of butter depends upon the purity of the water used. If the water contains no foreign matter that will affect the butter, it keeps the better for having the buttermilk washed out instead of worked out. Evidently the grain of the butter will be more perfectly preserved if the buttermilk be removed by careful washing. The grain is such an important factor in the make-up of fine butter that it is necessary we should be very particular not to injure it in any way if we would excel in the art of butter-making."—*American Dairyman.*

"Upon this question, also, the doctors disagree. Our own preference is for washing the butter, especially when a large quantity is made. If the churning is stopped at the proper point, the butter will be gathered in little granules from the size of a mustard seed

to that of a pea. If, now, the buttermilk be drawn off, and pure, cold water be substituted, the particles of buttermilk which would otherwise adhere to these granules and be incorporated in the mass of butter will be far more effectually removed than can be done by any working. After our butter has been washed through two or three waters, we work it slightly, but it requires far less working to remove the surplus water than it would to remove the buttermilk, and hence we avoid the salvy appearance which arises from overworking. If the butter should happen to come a little too warm, the addition of cold water brings it immediately to the desired hardness, and largely prevents its loss of colour." —*Agricultural Paper.*

If the process described is faithfully followed, there will be no more buttermilk left in the butter than the action of the brine will take out. There is no doubt but that such butter, perfect in grain and free from foreign substance, may be packed into suitable tubs, *without salt*, and will keep quite fresh for months.

It is worthy of notice here that this new plan of washing has, besides the advantages already noted, a further advantage of making unnecessary the "working" of butter. The following practice of a butter-maker, who *packs directly from the churn*, will be at least suggestive of the possibilities of the granulated-washing system of butter-making:—

"I notice that C. B. T. mentions that he has had trouble in gathering his butter; that is, the granules of butter will not separate distinctly from the mass. Probably the more he churns, the 'finer' the butter grains become. If instead of trying to gather this butter another plan is pursued, I think he will overcome this trouble, and perhaps see why he does not need to gather his butter in any event. When this butter has refused to gather, if he will add a gallon of weak brine at 64° to the mass, and after agitating the churn for a few times will let it stand for fifteen minutes, and then carefully skim off the buttery substance that has appeared upon the surface, trying not to disturb the buttermilk, he will secure the butter. Then empty the churn, make another weak brine at 64° or 65°, and in this gather your 'fine' butter, which you will have no difficulty in doing.

"The idea of 'gathering' butter, in the old acceptance of the term, is not the best way, but rather work this unneeded buttermilk out with weak brine than to 'gather' it out, which is a perfect way to 'gather it in,' and in the after-working to expel it reduce the grain of the butter to a waxy condition that so detracts from its value. Water and salt do not enter into any combination with butter fats, but do have an affinity with the caseous matter of the milk, and in this way butter can be freed from buttermilk, specks, etc., without any great mechanical effort. Mechanical methods of separating buttermilk from the butter all have their damaging effects upon the grain of the butter.

"At the recent Dairy Fair at Milwaukee, one of the finest samples of butter on exhibition was one that was packed into the package directly from the churn, and that maker has sold his entire season's product made in this way for 58 cents per pound. His process is very simple. He does not allow the milk that is taken off with the cream to thicken before churning, but frequently stirs the cream and churns as soon as ascidity is discernible. As soon as the butter appears in the granular state he stops churning, and adds a couple of gallons of weak brine, and allows this to stand for half an hour, occasionally giving the churn one turn. This fluid is then drawn off, a pail of clear water put in its place, and after a few turns is also removed. Then a brine, made of seventy-three parts of water, and twenty-seven parts of fine salt, is put into the churn, and the butter is gathered. The package is then brought up alongside of the churn and the butter pressed into it, a damp cloth being brought into requisition to remove the surplus moisture that appears as the butter is being made solid in the package.

"If any plan can be substituted that involves less labour than this, and yet secures such perfect results, it would be a great favour to our butter-makers to be put in possession of the method. By this plan there can be no overworking; no remaining buttermilk; no surplus salt, and no breaking down of the grain of the butter. There is a perfect meeting of the requirements of practical butter-making, and the obviating of many perplexities that encumber the maker of actually fine butter by traditional systems."—*J. G., in Country Gentleman.*

"The scientific method here cannot be too strongly recommended. The main ad-

vantage hitherto possessed by the creamery over the dairy was the churning at one time, in the one case a quantity sufficient for one or more packages, and in the other case of only a few pounds at a time—it taking several churnings to fill a single package. This may be overcome by the simple method of washing the butter in a granulated state, and keeping each churning, unworked, and consequently still in small particles, in a covered receptacle of brine, until a sufficient quantity would be gathered to pack one or more full tubs at a time. This will enable the operator to choose a favourable day and season for packing, to save time and labour by doing up the work at one time that otherwise would be done at many times, both inconvenient and unfavourable, and will result in the production of packages uniform in every point—colour, salting, consistency, etc."—*W. H. Lynch in Canadian Farmer.*

"It should then be removed from the butter-milk, and well washed in plenty of pure cold water, or better still, cold brine. Butter, churned properly, requires very little working to free it from the milk. Washing is much better, as there is no danger of either water or brine injuring the grain or flavour."—*Prize Essay, Ingersoll, 1883.*

"When the butter has granulated about the size of a wheat kernel the churn should be stopped and the butter-milk drawn off through a strainer, so as to catch all the small particles. Cold water should then be added, and the churn moved backwards and forwards, so as to wash the butter; then run off the water. Apply cold water a second time, washing as before."—*Prize Essay, Ingersoll, 1883.*

"Some use a sprinkler for washing the butter. The batch of butter, or the 'churning,' say of twenty to twenty-five pounds in weight, is laid upon the butter-worker, and water applied from a sprinkler or small watering pot. It is provided with a rose nozzle so as to distribute the water over the mass in numberless small streams. The watering-pot is held with the left hand, and the butter worked with the right hand at the same time, by applying the lever, going rapidly over from one side of the mass to the other.

"The butter being on the inclined slab or bed-piece of the butter-worker, the butter-milk flows off readily, and by a few movements of the lever the buttermilk is expelled. When the water flows from the mass without being discoloured the process of washing is completed. The sprinkler should be of small size, or no larger than can be conveniently handled with the left hand in the manner above described. The water, falling in a spray over the whole surface of the butter, cools it and gives the proper degree of hardness for working with the lever, a point of considerable importance, especially in hot weather."—*Willard.*

Salting.

Salting is the next and last work before packing. If we have made our butter properly we shall now salt with a different object than the usual one. Butter has been usually salted to *make it keep.* We shall use salt to make the butter suit the taste. The butter thus salted will perhaps keep best; the grains are intact and firm, and well closed together, with no leavings of buttermilk in it to make it spoil. Now, let the salting be done without applying the hands. The touch of the hands will more or less spoil the result of our painstaking all through the now nearly completed process. The heat of the hands will partially melt the butter. To get an idea of the effect of heat upon butter, thoroughly melt a prime article and let it cool, then compare the taste with before, or undertake to put the thing that *was* butter back to its original state. To learn how much heat there is in one's hands, wash them a few minutes in a basin of cold water and note the change in the temperature of the water. Now if the salt be good and worked in evenly we shall have a prime article, something that has a good taste and flavour, and, what is better, something that will, unlike most of butter marketed, retain its good taste and flavour until, in the natural course of events, it reaches the table of the consumer.

"The best rule for salting butter is to salt to suit the taste of the consumer. There is no use applying any particular amount of salt for the sake of preserving it, because the very lightest salting is more than sufficient for all the effect salt can have as a preservative of butter. Generally one ounce of salt to sixteen ounces of butter."—*Colorado Farmer.*

"You will discover that there is a considerable amount of water in the butter, after taking it (in the granulated form) from the last rinsing; how much I could not tell you, as this knowledge comes only from experience. I next put 1½ ozs. of salt *through a fine seive on the butter*, and after working I consider that there will be about ¾ oz. per pound left, though this *will have to be regulated by the taste of the consumer*. I find that persons living near the sea need less salt in their food than persons inland need. In salting your butter for market the taste of the consumer should be your guide. You must cater to the wishes of your customers."—*Lewis, 1883.*

"If at the last working there is additional salt required, care must be taken that the salt has not become dry, so that it will not be dissolved, and many dairymen throw a few quarts of water into the worker, at this stage, to aid in dissolving the salt, and carry with it the particles of butter-milk that have remained over from the previous working."—*Maryland Farmer.*

"There is a mistaken notion in regard to salt adding to the keeping quality of butter, the truth being that salt will preserve the different substances occupying the interspaces between the globules of butter, for it is a fact that no chemical union ever takes place between the butter and salt. The long-keeping Dutch butter perfectly worked, but never receiving a particle of salt, proves the latter is not, so far as it relates to the keeping of butter, a preservative agent, and that no amount of salt will keep butter, unless certain rules are observed and requirements met. The papers teem with notices of butter preservatives and inventions to keep butter indefinitely, but it is probably a long time before any of them will come into general use; and for years to come the long-keeping butter will be found to be an article made from cream, where perfect cleanliness was observed in obtaining it, and the butter churned and put into packages, under a system of rules relating to age of cream, temperature and working."—*Maryland Farmer.*

"If the butter has any undesirable flavour or is insipid, a little more salt may be used, say one ounce to twelve or fourteen ounces of butter, so as to obscure in a measure the faulty taste, the flavour of salt being less objectionable than a wrong or defective taste in butter. But if the flavour is very fine and full, it will not be desirable to hide it, but on the contrary to give it prominence; hence less salt, say one ounce to twenty pounds of butter, will give a better effect."—*Colorado Farmer.*

"For use within a week or two, the proportion of common salt employed is about half an ounce to two pounds of butter, though, where it has to be kept some time, as much as one ounce of salt to one pound of butter is used."—*Chambers' Encyclopædia.*

"When the buttermilk has been expelled, the butter is ready for salting, and the butter-worker is used for incorporating the salt evenly through the mass. Salt is now added, and worked through the butter with the butter-worker, at the rate of eighteen ounces for twenty-two pounds of butter. Great care is taken that the salt be pure, and of those brands that are known to be free from the chloride of calcium—as a trace of this impurity gives a bitter taste to the butter. For butter that is designed to be kept over for the winter markets, a little more salt is sometimes used, often as high as an ounce of salt to a pound of butter. Not unfrequently a teaspoonful of saltpetre and a tablespoonful of white sugar are added, at the last working, for twenty-two pounds of butter.

"Considerable discussion has recently arisen about the use of saltpetre in butter, some holding that it cannot be healthful even though employed in small quantities, that it adds nothing to the flavour or quality of the butter, that it has no preserving properties, and hence should be banished from the dairy by all good butter-makers. Without entering upon an elaborate discussion of this question it will suffice, perhaps, to say that saltpetre has been used from time immemorial in curing meats, and of the thousands who thus annually employ it, I have yet to hear of a single authenticated case where it has proved injurious.

"The butter-makers of Orange County claim that, by the use of saltpetre, butter will retain its flavour, and keep sound longer in hot weather than when it is not used. They say that many direct experiments have been made to test this point, and in every instance the samples of butter cured with saltpetre, kept sweet longer and were better saved than those samples where it was not used. For curing butter made in summer, there-

fore, the following mixture is often used, viz.: For every twenty-two pounds of butter sixteen ounces of salt, one teaspoonful of saltpetre, and a tablespoonful of the best powdered white sugar. In preparing this mixture, salt is crushed under a roller to free it from all lumps; it is then run through a sieve, and then saltpetre, after being reduced to a powder, is evenly mingled with the sugar through the salt.

"In the matter of salt, however, the factories adapt the quantity to suit the taste of their customers, or for different markets. Of late years, light-salted butter sells best, and the rate of salting varies from one-half to three-fourths of an ounce of salt to the pound of butter. The butter, after having been salted and worked, is allowed to stand until evening and is then worked a second time and packed. In hot weather, as soon as the butter is salted and worked over, it is taken to the pools and immersed in water, where it remains until evening, when it is taken out, worked over and packed. For this purpose a separate pool is provided, which is used only for butter; it is called the 'butter pool,' and fresh spring water constantly flows in and out of it, as in the pools for setting the milk."—*Willard.*

"After the milk has been thoroughly washed from the butter, the salt should be lightly worked in, about 8 ounces of salt to 10 lbs. of butter is a good proportion; it is then closely covered and set away for about twenty-four hours, or until the salt is all melted, which will depend on its fineness, and the humidity of the atmosphere.

"The butter should then be worked over 'just enough,' that is, enough to extract all the cheesy matter which would spoil its keeping qualities, and not enough to break the grain, which would destroy its appearance and flavour. When worked just right it will look as if it had beads of dew standing all over its surface."—*Prize Essay, Ingersoll, 1883.*

Salt—To test its Purity.

"Expose a portion of the salt in a thin layer on a flat plate to the outer air for a few hours at night. If, on examination, the crystals or grains of salt are found to move freely, like sand, it may be considered pure, and used without hesitation. But if the particles adhere together in lumps, or if any moisture is apparent round the edges, it it may be at once condemned as unfit for use."—*Prof. Bell.*

"Observe its behaviour in damp weather. If, when the weather is damp, salt will attract moisture enough from the air to appear wet, it is unfit for putting into butter or cheese. Pure salt remains dry in wet weather. It may stand in a cellar all summer without being sensibly moist. It is the impurities in salt which attract moisture and make it appear wet; hence salt which will vary with every change in the hygrometric condition of the air should be rejected by dairymen as impure and unfit for their use."—*Arnold.*

Packing.

"The package should be prepared for the butter, by soaking in hot brine."—*Lewis, 1883.*

"When the butter has attained sufficient solidity to pack, I immediately pack it, as I desire to exclude the air. The butter should be placed in after the package has been cooled to the proper temperature (after having soaked in hot brine), and when nearly full the tub might be filled with brine and headed up."—*Lewis, 1883.*

"It is then ready for the tubs or firkins, which should be of such a size that they could be completely filled at one churning, so as to secure a perfectly uniform colour and quality all through. They should be made of oak, ash, or maple, no iron of any kind about them, and are to be prepared for the butter by a thorough scalding with brine—the best way is to fill them with the brine, boiling hot, and let it stand in them until cold. They are then ready for the butter, which should be packed firmly and closely into them, until about an inch from the top, when it should be covered with a thin muslin cloth, and the firkin filled up with salt, and closely headed up, so that not a particle of air can reach the butter."—*Prize Essay, Ingersoll, 1883.*

"Work it over with the ladle till it comes to a uniform colour and texture, and pack it (if in tubs) as tight as possible, pressing it down solid with the ladle. The tub when

finished should be filled with strong brine and made air-tight, and I would guarantee its good condition in market.

"Tubs for packing should be steamed with hot brine, with a little saltpetre dissolved to remove the wood taste."—*McNamee, Brockville, 1883.*

"Much butter is spoiled by being packed in tubs that are not first thoroughly soaked in strong brine. If the wood is first filled with brine the butter will not stick to it, nor will the wood absorb the salt from the outside of the butter, leaving it white, fresh, and subject to rapid change. The same brine will answer to fill new tubs for an indefinite period, if care be taken to keep it strong by putting more salt liberally and often."—*Mr. Belknap, Ex-President of National Butter, Cheese and Egg Association.*

Marketing.—Putting up Butter for a Local Market.

"I prepare my butter for a 'near by' market as follows: I weigh each pound and balance the scales at 17 ozs., in order that there may be a full pound to the customer when finished. The butter is rolled to the proper thickness, pressed so it would be as thick as broad and twice as long as broad, with a ridge marked in the centre. This is cut in two pieces with a piece of wire, leaving it in cubes of half a pound each. They are wrapped in parafine paper and packed in boxes holding eighty-eight and 100 pounds." —*Lewis, 1883.*

"When a couple of tubs (on small farms and about five or six on large farms) have been filled, they are immediately forwarded to the merchant, who receives it quite fresh, for the best butter loses its firm taste and smell after a few days keeping. During the months of June and July, when prices are low, the producers try to keep it longer, in order to get more for it. But as butter invariably loses weight and quality by being kept, it is always a risky speculation, for the consumers, who pay the highest prices, require more and more that the butter should be freshly churned, so that the sale of butter which has been kept becomes harder and harder to effect, and it is now acknowledged to be better to send it away as soon as made."—*Danish Butter-Making.*

"In order to sell cheese successfully it was necessary to have, first, quality; second, reputation; and these two would bring the third, 'a good price.' Quantity also came as a factor for obtaining a good price. A salesman should make a point of retaining or keeping back any cheese that was not up to the standard of the season's produce. There was scarcely a baker who did not occasionally make a poor batch of bread, and there was seldom a factory that did not occasionally have a bad vat of cheese. It was too often the practice of salesmen to box up this inferior cheese, and, nailing down the covers, do their utmost to deceive the dealers. Very possibly its quality would never be known till the cheese was sold in the English market and cut up. The grocer who bought it would, of course, have no redress, but in all probability he would decline to purchase Canadian cheese the next time he was offered any. These same grocers were the very people who were to be the best customers of the Canadian cheese-maker, and it was certainly very bad policy to defraud them."—*McPherson, Eastern Ontario "Cheese King."*

"At the close of Mr. McPherson's address Mr. Whalen, of Centreville, asked him as to his method of selling the product of his factories. In reply Mr. McPherson said that he now sold all his product by telegraph. He was fortunate enough to have such a reputation that no buyers ever saw his cheese till it was sold and shipped to them. This announcement was received with vigorous cheers and hearty expressions of approval by all the dairymen present."—*Dairymen's Convention.*

"In reply to questions, he said that print butter, or 'trunk butter,' as the Boston dealers call it, is in over-supply every summer, and as it will not keep long it has to be sold low. A few dairies which are always in demand, because customers will have them, can be kept up above the quotations, but the number of such dairies is comparatively small. Print butter is needed, and tub butter for long keeping is needed, and a farmer must be governed in his selection according to his circumstances. If he has a poor cellar he had better send off his butter, whether in prints or tubs, as fast as it is ready. It costs a great deal of work to put butter into tubs, and the best prices of the year can be obtained if it be kept sweet."—*Prof. Wetherell, Brockville, 1883.*

"The next quality of butter after taste is the appearance, for if the appearance of a tub, package, or roll of butter is such as to create a favourable impression on the mind of a buyer or inspector, a great deal is gained in favour of the article. The appearance I am trying to describe should consist of a rich yellow colour; a solid compact texture showing when taken with the pierce (tryer), or cut with the knife, a perfectly smooth, glassy surface, and as near transparent as possible."—*McNamee, Brockville, 1883.*

The Trade Problem.

"If a great part of our butter trade could be got out of its present channels, and butter, like everything else, bought on its merits, there is no doubt much good would speedily result. The farmers have been in the habit of trading this commodity with the storekeepers, and these are so anxious to cultivate a trade with the farmers that they are afraid to discriminate in price, for fear of offending some of their customers and thus losing their trade; so the various classes of producers have been kept from that mutual improvement that would speedily result if a first-class price were paid for a first-rate article. Just as surely as self-conceit would yield to self-interest, would a knowledge of the conditions requisite for producing good butter become speedily diffused, and great improvement in the product would result, as has been the case in districts where a more rigid system of grading has been adopted."—*John Smith, Ingersoll, 1883.*

"The main featnres that characterized our butter years ago, characterize it still —entire want of uniformity as to the general make-up, and eternal uniformity as to its table qualities, being uniformly bad.

"This state of things is not to be wondered at; indeed it would have been strange had it been otherwise. Few people unfortunately do good for the love of the beauty of goodness. For a farmer to make a good article of butter, under the present system of managing the trade, was to entail upon himself an actual loss; it was an act of folly on the part of the farmer's wife, to work out a pound or two of milk from ten or twelve pounds of butter, when that milk could be sold in the butter for the same price as the article itself, and it was just as great an act of folly to be at all parsimonious with the salt, when salt could be bought by the barrel at one-third of a cent per pound, and sold in the butter at from twelve to fifteen cents. Few farmers' wives cared about acquiring a reputation for their dairy produce, when that reputation had to be gained by an actual loss to themselves. Those dairy women who could and would have made good butter, were deterred from doing so when they saw their neighbours across the way get as much from the storekeeper for their pails full of slop, part grease, part buttermilk, and part salt, with the other ingredients mixed, as they could get for a good marketable article.

"The shipper looked over the stuff in the cellar of the storekeeper, and suggested better management. The storekeeper hinted mildly to the farmer certain improvements which might be introduced, whilst the farmer, he censured both the storekeeper shipper for the want of discrimination in values.

"So the trade moved on, European countries supplying the workingm[illegible] with good butter, while the product of Canada (whose natural adapt[illegible] farming is second to no country in the world, and should have stood a[illegible] head [illegible] list for her butter, as she does for her cheese) was consigned to the cellars [illegible] confectioners and patent grease manufacturers."—*Prize Essay, Ingersoll, 1883.*

UTENSILS

may provide against lack of skill or unsuitable dairy room.

This may be seen in the value of the use of a strainer while milking, and allowing the milk to fall in a closed vessel, thus securing against both dirt and odours.

The odours taken in the milk during the milking may have a bad effect that will run through the entire existence of the butter. The gilt-edged butter-maker is so careful to secure against the odours of the milking-place that he will not allow the milker to enter the milk-setting room.

"The use of a right kind of milking-pail will further these objects of the milker to keep the milk free from impurities and at a high temperature. Milking into a closed pail, which strains the milk while it is being drawn, and slowly, obviously is much better than milking in an open pail that allows all the dirt to fall in the milk and soak thoroughly (to be only partially strained out by hurried, forceful straining), allows surrounding odours full access to the milk, and also allows the milk, while in the pail, to cool rapidly." —*W. H. Lynch, in Canada Farmer.*

It may be seen in the use of a milk-holding vessel, which ventilates the milk, or allows the odours to escape, and yet excludes impurities in the surrounding atmosphere.

"The peculiar smell of a cellar is indelibly impressed upon all the butter made from the milk standing in it. A few puffs from a pipe or a cigar will scent all the milk in the room, and a smoking lamp will do the same. . . . A maker of gilt-edged butter objects to cooling warm milk in the room where his milk stands for the cream to rise, because, he says, the odour escaping from the new milk, while cooling, is taken in by the other milk, and retained to the injury of his butter. This may seem like descending to little things, but it must be remembered that it is the sum of such little things that determines whether the products of the dairy are to be sold at cost or below, or as a high-priced luxury. If milk is to be converted into an article of the latter class, it must be handled and kept in clean and sweet vessels, and must stand in pure, fresh air, such as would be desirable and healthy for people to breathe."—*Arnold.*

There will be a great advantage in having a milk-setting vessel so constructed that impure odours cannot reach the milk.

The use of a strainer to draw off the buttermilk is of great service. There is no part of the scientific method of more importance than that of separating the buttermilk from the butter. The effect of the proper carrying out of this process by all butter-makers would be a revolutionizing of the dairy industry completely, and the creation of a butter trade that does not now exist. It would perhaps take ten, it may be twenty, years before the practice would become general from the abstract teaching of the people through the press, etc. The introduction along with dairy supplies of a strainer adapted to the simplest carrying out of the process would, in less than half the time, lead to the practice being more generally adopted and more thoroughly carried out.

The Thermometer.

So long ago as a quarter of a century Mr. Flint quotes a premium butter-maker of Massachusetts as saying: "The thermometer should always accompany the winter dairy."

"Temperature, which is so important, may be determined to the necessary certainty only by the aid of mechanical help, such as is afforded in the thermometer. The thermometer may indeed be called the key to scientific butter-making. No other one thing has so much as the thermometer to do with a right process of making butter, or butter-making by rule. In past time, when butter-making was purely a rule-of-thumb process, the value of the thermometer was not known. As intelligent methods began to take the place of hap-hazard ways, the use of the thermometer came to be considered by advanced makers a necessity, and to-day there is no one thing that better distinguishes the advanced dairyman from the dairyman of primitive ways than the regard for temperature, which calls for the use of the instrument which tells the temperature. If it is still true that this useful, simple and cheap instrument is not to be found in one in ten of our dairies, it is equally true that our butter has accordingly low average quality. It has been claimed on good authority in different parts of the country, that not more than ten per cent. of our butter is what it should be for shipping purposes. It is doubtless safe to say that when nineteen out of twenty of our dairy farmers come to believe that they cannot afford to be without a thermometer the condition of things will be reversed, and ninety instead of ten per cent. of our butter will be of prime quality."—*W. H. Lynch, in Canada Farmer.*

"The uncertain action of manual and other powers in churning can be considerably lessened by the careful study and use of the thermometer, without which the result will be doubtful."—*Prize Essay No. 1, Cork, 1878.*

Thermometers are necessary to give temperature of the milk-room, of the milk for setting, of the cream for ripening, of cream for churning, of the butter for working. Amount of labour and general uniformity of good result is dependent upon the thermometer. The sense of feelings of the average dairyman or dairywoman may not determine within upwards of five or ten degrees the proper temperature, upon which so much depends.

Strainer Milking-Pail.

Milk in general practice stands open to the air in the place where the milking is done. The loss that comes of this practice is not fully appreciated. Says Prof. Arnold: "A pail of milk standing ten minutes where it will take the scent of a strong-smelling stable, or any other offensive odour, will imbibe a taint that will never leave it." Speaking of one of the causes which increase the odour in milk and give trouble in the working of it, he says that a very efficient one is "exposing milk to foul odours at the farm-yard and at the factory." Again he says: "Milk, being full of oily matter and holding albuminoids and sugar in solution, offers to every species of ferment just what is most desirable for it to flourish in. Every odour that comes in contact with milk is grasped and taken in at once, and its grasp is never slackened. Once taken in it is there permanently, and the seeds of every ferment that touches its surface find such a fertile soil to flourish in that they spring at once into vigorous growth, and multiply and leaven the whole lump." "It is a fact which cannot be too strongly impressed upon the mind of everyone connected with the care of milk, or the manufacture of milk products, that milk takes in every odour as well as the seeds of every ferment that blows over its surface."

(Cleanliness in Milking.)

"The manner of milking in the Channel Islands, the home of the Alderney, is peculiar, and has the merit of cleanliness at least. Milking and straining are done at one operation. The strainer is securely tied over the narrow-mouthed bucket, and placing a large, shallow shell on the strainer she vigorously directs the stream into the shell; overflowing the shallow brim the milk passes through the strainer into the receptacle beneath, the shell being used simply to prevent wearing a hole in the linen strainer." (And it might be added preventing the milk from spattering, etc.)—*Witness.*

"My cows are Jerseys and Guernseys; but I do not regard the breed or feed so important as cleanliness in the stable and neatness about the whole process of making butter. I would have sweet feed and no odours about the barn for the cows to breathe. *Just as soon as the milk is drawn let it be covered up or taken from the barn."—E. F. Bowditch, Fancy Butter-maker, at Greenfield Butter Convention.*

"Dr. Voelcker, who is probably the highest authority in such matters, is of the opinion that the extraordinary care and *cleanliness* sure to be taken in dairies where they go to the trouble of the iceing process is the chief cause of the excellence of their butter." —*Irish Prize Essay.*

"Cleanliness, scrupulous cleanliness, almost religious cleanliness, is of the first importance in butter-making; for uncleanliness *does as much harm as impure milk.*" "Any filth that finds its way into the milk at this (the milking) stage, as at any other, hastens its decomposition."—*Sheldon, at International Dairy Show, Dublin, 1879.*

"The straining of the milk cannot be too rigidly enforced, as the presence of impurities in the butter deteriorates its value."—*Prize Essay, No. 1, Cork, 1878.*

"Practically, excessive cleanliness is the first and second and third most important thing in butter-making; ordinary cleanliness won't do; it must be extraordinary. Without extreme cleanliness all else is useless. It should go so far that no speck of dust or dirt should be allowed in the dairy, nor a drop of spilt milk. . . . There should be no bad smells either inside or outside the dairy. Milk and cream *have the power* of absorbing the foulness of any sort of bad smell, and are thereby put more or less in a condition of corruption."—*Prize Essay, No. 3, Cork, 1878.*

"And all this care, watchfulness, cleanliness are necessary because milk is a quick absorbent of any impure odours or decay-germs that the air may contain; because it is

continually on the lookout, as it were, to seize on anything that will hasten its destruction; and because it is impossible to make very good cheese or butter from milk that has become tainted with any kind of impurity. This subtle power of absorption, which milk possesses in a higher degree than most other liquids, increases the difficulty of producing fine qualities of cheese and butter until it is understood; carelessness after that is inexcusable. Thorough cleanliness of utensils, milk-rooms, atmosphere, everything in fact that comes into contact with milk may justly be said to be one of the most important essentials in the dairy, and the neglect of it, in one way or another, is one of the chief causes of most of the ill-made, ill-looking, ill-flavoured and ill-conditioned cheese and butter—especially butter—that we find everywhere in the country."—*Sheldon.*

"The use of a right kind of milking-pail will further these objects of the milker to keep the milk free from impurities and at a high temperature. Milking into a closed pail, which strains the milk while it is being drawn, and slowly, is obviously much better than milking in an open pail that allows all the dirt to fall in the milk and soak thoroughly (to be only partially strained out by hurried, forceful straining), allows surrounding odours full access to the milk, and also allows the milk while in the pail to cool rapidly."—*W. H. Lynch, in Canada Farmer.*

"Of course strictly fancy butter cannot be made unless every step in the process is taken with care and skill. One wrong practice would be fatal to fancy butter, for a wrong step once taken in butter-making can never be recalled nor effaced. Its effects will run through the entire existence of the butter."—*Arnold.*

Prof. Arnold speaks of the practice of a dairyman in Franklin County, N. Y., who provided against milkers entering the milk-room. He said of the result: "This prevents the milkers from carrying any filth into the room, of polluting the atmosphere by any scent of the barn or milk-yard that might attach to the clothes. In this way the air in the milk-room is kept in the purest possible condition, and the milk is effectually prevented from absorbing any foreign odour whatever." This dairyman was reported as making not only more but better butter than was made by the very excellent butter-factories, or dairies, in the neighbourhood. Cleanliness here was an actual and a double profit. Anything that will help to secure cleanliness, therefore, is a money value as well as other advantage. Prof. Arnold says, in other connection: "If all the milk of which butter and cheese are made could be taken to the dairy-house as undefiled as it exists in the udder, the price of those luxuries would be at once materially advanced."

The strainer milking-pail will secure cleanliness in milking and against bad odours. This will affect the action of the cream all through—in rising, in churning and the keeping qualities as well as eating qualities of the butter.

Creamers, or Milk-setting Vessels.

Special attention has lately been given to the sort of vessel that is best to hold the milk while the cream is rising. In some localities the new creamers are in the most favour, some dairy-keepers like best the large pans, others hold fast to the old-fashioned shallow pan or earthen bowl.

The little open pans that have so long and well served the need of the dairymen evidently do not fully meet the wants of the dairymen of to-day. By having larger sized vessels and fewer of them the objects are attained, at least, of less labour, more convenience and greater cleanliness, and perhaps less cost. If larger yield and better quality of cream can be secured by the use of larger-sized vessels, then the inferiority of small, open pans will be established. But while this is true, these vessels have been used by good butter-makers and with excellent results, and they are widely used to-day. This is reason enough for instructions for their use in the best way to get a good result.

"The old system of setting milk in shallow pans is now practically denounced in the United States, and the deep canned system has gained the approval of the leading dairymen of the country."—*Prof. Sheldon, Dublin.*

"Deep and shallow-setting both have their advocates, and either process may be better than the other under certain conditions. If, for instance, the only means for cooling the milk be the air of a cool cellar, or the water of a slow-running spring, then

shallow-setting is in place, and by it excellent results may be obtained. If the milk be properly managed, as much butter may be obtained, and its quality will be fully equal to that obtained by any other method. Indeed, it has been our experience that for the management of the milk of one or two cows, neither ice nor spring water are at all necessary. This process, however, entails more labour than deep-setting, since there are more vessels to care for; and hence, were we conducting a large creamery, we would certainly arrange to use ice or spring water, or both, and to practice deep-setting. Several patented appliances are now made for this purpose, which have the merit of great convenience."—*Agricultural Paper.*"

"It makes little difference how the cream is raised, but I prefer deep-setting on account of its convenience."—*Mr. Bowditch, at Greenfield Convention.*

"The recent improvements in apparatus for raising cream now separates it so perfectly as well as quickly that factory men are now able to make a pound of butter from less than twenty-five pounds of milk of average quality."—*Prof. Arnold, in Farmers' Advocate.*

Excluding Impure Odours—"Milk must be treated with the utmost care after drawing. Milk has a high absorbing power, and the greatest care must be exercised with it in order that this may be guarded against. You may expose milk to impure odours from which no after treatment will enable you to make good butter."—*Lewis, 1883.*

"It is a fact which cannot be too strongly impressed upon the mind of every one connected with the care of milk, or the manufacture of milk products, that milk takes in every odour as well as the seeds of every ferment that blows over its surface. Milk being full of oily matter and holding albuminoids and sugar in solution, offers to every species of ferment just what is most desirable for it to flourish in. Every odour that comes in contact with milk is grasped and taken in at once, and its grasp is never slackened. Once taken in it is there permanently."—*Arnold.*

"A maker of gilt-edged butter objects to cooling warm milk in the room where his milk stands for the cream to rise, because he says the odour escaping from the new milk, while cooling, is taken in by the other milk, and retained to the injury of his butter."—*Arnold.*

"In Denmark the secret of their success lies in the low temperature of the milk-houses obtained by the free use of ice. American ingenuity has simplified the process by the invention of the "total submersion" system, which can be carried on in an open shed. Purity of atmosphere where the milk is set and the butter worked and packed is of the utmost importance also, and this, so far as the milk is concerned, is most easily obtainable by the submersion process."—*Journal of Commerce.*

"I do not hesitate to say that pure butter cannot be made in any open method of setting, cooled in any way, and the lower the temperature the poorer the quality of butter, taking the well-known case of a pitcher of cold water setting on the table on a hot summer day. We see small and numerous drops of water on the outside, which are the results of condensation. Whatever exists in the room and its adjoinings, in the form of vapours, steam, gases and odours coming from any source, such as out-houses, sick-room, vegetable cooking, etc., is condensed on the pitcher and on the top of the water, and, indeed, anything that is cooler than the room, and the colder the water-pitcher or the milk the greater the power of condensation. It is a well admitted fact by physicians that water standing in a sick-room soon becomes unfit for use, because it has absorbed so much foul odours and gases. Go to cleanse a sick-room from bad air and foul odours, cold water is recommended to be set in the room, which makes a powerful condenser, and the colder the water the more impure it becomes, and of course the more pure the air becomes. Now transfer this principle to your milk-room, in which your open milk cooled takes the place of water operating as a condenser. A trap to absorb and retain impurities from any source whatever. And remember this is lodged in the cream, and of course is retained in the butter, except what passes off in the buttermilk."—*Brockville Convention, 1883.*

Drawing off Cream.—"In the Swartz system the cream is thin and has no skin, but let it not be imagined that this makes it more difficult to completely skim the milk, for the coating of cream is easily removed from the skim or blue milk. Still care must

be taken in creaming, and the operation requires practised and careful handling. By means of the skimmer, the cream is first raised on both sides, the spoon or skimmer slipped under and the operation continued until the blue milk appears. Then the skimmer is slowly drawn over the whole surface and filled with cream. After some practice, a skilful person can skim a can in one or two minutes, quicker than with a tap. By thus creaming at the top of the can, one is sure of getting pure cream which has not been mixed with the sediment which is often found at the bottom."—*Barre.*

"Those more recently used are round, high and narrow, of oval form. *They have neither covers nor cocks.* Creaming from the *bottom* with a tap is considered in Denmark as a bad practice."—*Barre.*

Need for Heating the Milk.—"Flecks usually come from a faulty condition of the milk, and the butter made from such milk should not be mixed with other butter, as it will not keep like butter from sound milk. They may be prevented by scalding the milk in which they occur to 130°, to kill the germs which occasion them. When the milk is very much affected a higher heat will be necessary."—*Country Gentleman.*

Application of Cold and Cooling, Sheldon.—"Mr. Hardin claims that the cream raised by his method is firmer and solider than in other deep-setting systems, because it is cooled mainly from the top, the lumps of ice being on a shelf just above the milk. If this claim be substantiated it is no doubt a point in favour of his system."—*Arnold.*

Creamers or Improved Milk-Setting Apparatus, when Vessel Containing it is plunged in Ice or Cold Water.—"The milk cools very unequally, the milk at the bottom of the pail cooling much faster than at the surface." (Prize Essay No. 2, Cork, 1878). When vessels are surrounded by water at the top but open beneath to the atmosphere, "Mr. Burnetts' (of Rosborough, Mass.) idea is based on the law that fluids warm quickest by applying the heat underneath, and that when the layer of milk at the bottom is warmer than at the top, the warmer and consequently lighter atoms must ascend to the top much quicker than in the ordinary system, when the heat is warmer at the surface than at the bottom. Mr. Burnett claims that by his method he not only obtains a far larger percentage of cream, but that as it rises in twelve hours the milk is still sweet and saleable, and the cream being untainted also from being set such a short time, produces butter uncommonly well flavoured."—*Prize Essay No. 2, Cork, 1878.*

Should not be Hermetically Sealed.—"If the milk, directly it is taken from the cow, is put into these cans and hermetically sealed in the manner described, it would almost seem that the gases of the milk, being confined on the surface, can hardly fail, particularly in hot weather, to injure, however slightly, the quality of the cream. Aërating the milk before submerging it would remove all possible danger on this score."—*Sheldon.*

"Mr. Hardin's method of closely covering the milk retains all this aroma in the cream, but in this respect his plan appears a little *too* economical for general use. It saves all the cowy odour peculiar to new milk, which an abundant experience has proved to be detrimental both to the flavour and keeping of butter."—*Arnold.*

"Mr. Hardin assumes that milk is perfect when it comes from the cow, or ought to be, and that its defects come by contact with the air, and that the more milk is aired the worse it is for it, and that animal odour is a myth that need not be regarded, a position in which he is certainly wrong, etc., etc."—*Arnold.*

General Description of a Creamer.—"The best plan for raising cream, and the one which most perfectly accords with the science and philosophy of butter-making, is the following: The milk is set in tin vats twenty inches deep, but no more than sixteen inches wide, and the length variable as may be convenient. The upper half of each vat is surrounded by an envelope of water, ten inches perpendicularly and two or three horizontally. The water is run into the envelope at one end of the vat and passing equally along both sides runs out at the other end. The lower half of the vat is surrounded only with air, and it is all the better if the air is not very cool. This does the cooling at the top of the milk, where it should always be done. The law discovered and published by me several years ago, that *cream rises best when the temperature is falling*, is now recognized and adopted by all carefully observing butter-makers. When milk has reached a low temperature and it ceases to vary, the cream ceases to rise. The temperature of the milk must, therefore, be kept changing. These vats are perfectly adapted to

this law. If the milk becomes reduced to the temperature of the water flowing round it, the vats are arranged to warm the milk a little at the bottom, either by steam or water, sending the warmed part up to the top to be again cooled and precipitated, leaving the cream at the surface. The changing temperature can thus be kept up indefinitely without the necessity of extreme refrigeration, which is unfavourable to the production of the best keeping and finest delicacy of flavour. Refrigeration is all important in butter-making, but we may have too much of a good thing. Aëration is essential to cream while spread out on the milk, but airing does little or no good if the temperature is very low." —*Arnold, in Rural Home, 1882.*

The use of improved milk-setting apparatus will increase the quantity of cream obtained and improve quality. It will provide against unfavourable results from sudden changes in temperature; will keep dust and dirt away and give ventilation without taking in objectionable odours or germs from the atmosphere. It will save labour and require less constant attention, and help particularly to obtain a greater uniformity of result.

Cream Holder.

"The cream may be supposed now to be removed by the cream drawer to the factory and deposited in vats to ripen, or, in other words, to develop the proper acidity before being put in the churn. The vats containing the cream should set on an incline, with a faucet at the lowest point, in order that any sediment, which may accumulate in the ripening process of the cream, may be drawn off before churning."—*Prize Essay, Ingersoll, 1883.*

Churns.

It was lately remarked that in the patent office at Washington there seemed to be more of patent churns than of almost any other one thing. The experience of all the farmers in the country would create a ready belief in the statement. Yet, nearly every enterprising farmer has one or more unused churns that have not proved of advantage, and hundreds of manufacturers have unsaleable churns upon their hands. The essentials of a good churn are: *First*, Something simple in construction and easily worked. *Second*, Something that will make a fair quantity of butter in a reasonably short time. *Third*, That will not, in any way, waste the cream, and will be clean in working. *Fourth*, That will so work the cream as to extract all the butter possible. *Fifth*, That will so work the cream that the grains of butter, when the cream globules will have burst, shall be as nearly as possible in the natural form, not broken. This will ensure that the butter will be more firm, of better flavour, in a word, will possess good eating and keeping qualities. *Sixth*, That the cream may break into butter as nearly as possible *at one time.* In such case all the cream may be churned enough, and none of it over-churned. In this case, too, the butter may be separated better from the butter-milk while the grains are small, making it unnecessary to afterwards labouriously work out butter-milk to the injury of the quality of butter. *Seventh*, That after use it may be easily and thoroughly cleaned. *Eighth*, That it may be light and portable, yet substantial.

"The old dash churn is the handiest to operate; but when properly constructed (with a large dasher) it does its work in the best manner." There are other churns which operate essentially on the same principle as the dash churn, and do their work easier. Among these the oscillating churn, "which has a reciprocating motion, works easily, and produces its effects by causing the cream to strike the ends of the rectangular box with a thud as it suddenly changes the direction of its motion, producing an effect upon the whole mass of cream equivalent to the stroke of a large dasher in a dash churn. The barrel churn, revolving endwise, produces a similar effect; so also the revolving rectangular churns, whether suspended at the middle of opposite sides, as in rectangular (or box) churns."—*Arnold, 1879.*

"We have quite a number of churns that seem to produce as good butter as the dasher, with less labour. . . . We have the box churn that brings the butter by concussion, same as the dasher, then there is the oscillating churn, but the one I regard as superior to all others for the small dairyman is a barrel, hung at the two sides on the centre, and

revolves endways. The cream drops from end to end of the barrel and produces splendid concussion."—*Lewis, 1883.*

"The merits of churns are invariably decided by the following conditions, viz. :—The condition in which butter leaves the churn, its quality and quantity ; the facility with which the churn can be cleaned, and the time which the churning occupies."—*Prize Essay No. 1, Cork, 1878.*

"Over-churning or over-working has a like effect and should accordingly be avoided. Butter once made greasy loses its keeping qualities ; *its melting point is lowered, and it will not stand any high degree of heat afterwards without melting.* Danish butter derives much of its character from its high melting point, and its power of withstanding heat in warm climates, such as Brazil."—*Prize Essay No. 2, Cork, 1878.*

"Churns may be classified as vertical with upright dash, box with revolving dash, and barrel when the cask containing the cream is itself revolved. The two former kinds are most in use where the milk and cream are churned together, but where the cream alone is used the barrel is the favourite."

"The floats in a barrel churn should be plain and few in number—three are enough—so that they may be *easily cleaned*, and if they are so constructed as to tend to force the cream towards the centre, and create a double current, it is all the better. . . . . The defects in other classes of churns consist chiefly in their having metallic bearings, which, when they come in contact with the cream injures it."—*Prize Essay No. 2, Cork, 1878.*

"I prefer the churns that are put together like boxes, ... or the *end-over* barrel churn, ... not the swing churn ; any of these in preference to the *old* barrel churn (with dashers). . . . . I find that the churns I mentioned, by reason of their angles, will do the work with a minimum of dashers inside, whereas in a (horizontal) barrel churn a considerable amount of dasher is necessary, otherwise the milk would rotate with the churn ; therefore, in future, I shall avoid all barrel churns (with dashers). . . . . Concussion is what we want, and not friction ; and this we get, even without dashers, in a box form rather than a (horizontal) barrel."—*Allender on Dairying, Quebec Agricultural Journal, April, 1882.*

The oldest form of churn is the upright or *plunge* churn. There is a general prejudice in favour of this (plunge, or dash) churn, on the ground that the butter is more completely separated and of better quality. Its great defect is that the operation, being generally performed by hand, is fatiguing. Recent improvements have chiefly aimed at ease in working, and a saving of time."—*Chambers' Ency.*

"Churns on a centrifugal action have also been successfully used, particularly in Sweden."—*Chambers' Ency.*

"Recently churns with an oscillating motion like a child's cradle, have been introduced, but without any decisively superior results."—*Chambers' Ency.*

Right Principle of Agitating Cream.—"Somehow, by some accident—for I presume it was an accident—the old 'dasher' brings the butter upon a right principle—that is, the principle of concussion instead of friction. Any churn that produces friction upon the cream will ruin all the butter produced by it, by destroying the grain."—*Lewis, 1883.*

"The churning, too, must be philosophically done. The cream must all be acted on at once and alike, as when it falls from end to end in a barrel revolving endwise."—*Arnold, 1882.*

"As the act and object of churning is to fracture the shells of caseine, or whatever else they may be composed of, and set the butter free, it is important that the churn should be one that brings violence to bear on all the cream alike, or the cream will not churn equally, None are better than the modern barrel churns for this end—revolving churns with fixed dashers. The Holstein verticle churn and several of the American churns are also very good. The old perpendicular dash churn does its work well, but the labour of using it is very great."—*Prof. Sheldon.*

Quick Churning.—There has prevailed in the past a common notion that the main thing to be sought in churning was to have the butter come quick. Happily this notion is losing ground. The best butter-makers now are disposed to give the cream full time. It is said that in Orange County, Vermont, whose choice butter is well known, the

farmers especially favour slow churning, and will try perhaps as hard not to have the butter not "come" before thirty to fifty minutes, as some farmers whose success is doubtful try to bring the butter in fifteen to twenty-five minutes. One thing at least in this regard is sure; butter is no better for quick churning. Then if quick churning is not to improve the quality of the butter, it can have but one other object—to have the work of churning sooner done. If the churn works hard, then it is well that it does not need to be worked long; but if it works easy, and requires but little strength, the question of a few minutes gain in time ceases to be of much account, especially *when the quality of the butter* made is *affected by the length of time.* Now churns are constructed upon either one of two principles: first, to churn as quickly as possible; second, to churn as easily as possible. The first usually gains time at the expense of power, and thus, the churning being hard work, makes speed an object. The second makes the work so easy and agreeable, that it may be longer or shorter and make little difference to the worker, because the work is not tiresome. This is the main difference between the two kinds of churn, although, of course, different methods of construction may combine in varying degrees the several objects sought to be secured. From our point of view, preference will be given, other things being equal, to the easiest working churn that can be had. Of the churns of this principle of construction, we should make choice of that one whose general construction does best for both economy of time and adaptability to result. Then churning slowly or quickly the work would be agreeable, or it could be done, when necessary, by the weaker available help, and always with best results as to quality.

"All the quick operating churns are dangerous to use, and I would advise the members of this Convention, that when they find a man who has a churn warranted to bring butter in five minutes, to give him a wide berth. Ordinarily, it will spoil the butter in *two-and-a-half minutes.* It is ruined before you get it half churned."—*Lewis, 1883.*

"The form of churns has been improved so as to quicken the process of churning, but, in my opinion this improvement is quite unnecessary, for the increased rapidity in churning cream or milk cannot but have a detrimental effect on the quantity and quality of the product."—*Barre.*

Aëration Required.—"The disadvantages of the barrel churn are that it does not give the same facilities for aërating the cream as the other kinds, especially the vertical." "The spring vent is an improvement, but if a bar were so so arranged as to press on the stopper at each revolution, it would be still better."—*Prize Essay No. 2, Cork, 1878.*

Provision for Removing Butter-milk.—"By the French system (by which the splendid Norway butter is made, which sells in Paris for 3*s.* per lb., and nearly as dear in Rio Janeiro, salted or in tins) when the butter has just come in these fine grains, the buttermilk is drawn off by the vent hole through a sieve, the dairy-maid holding the spigot lightly in the vent, so as to let little butter escape. Spring water is then poured in and then drawn off in the same way after a few turns of the churn. This is done six or eight times till the water comes away quite clear, with no trace of buttermilk. It is thought in this way, the butter being in fine grains, and no lumps to hold buttermilk in them, the buttermilk is quite washed out. The only object of using the butter-worker then is to squeeze out any extra water in it, and so make the butter firmer (and to salt it)."—*Prize Essay No. 3, Cork, 1878.*

Upon the sort of churn used will depend: amount of labour; quantity of butter produced; quality of butter-grain, flavour, colour, taste, keeping quality, melting point, etc.; also, sometimes, *uniformity* of package.

Butter Press, or "Worker."

"The salting is usually done after the butter is taken from the churn, and for this purpose the butter-worker is the best of all, because it does less harm than the hands of the dairy-maid (unless she is very warm-hearted) to the grain of the butter."—*Prof. Sheldon.*

"For small dairies, the common wooden bowl and ladle are in general use, and, all things considered, are perhaps the best. For larger dairies, factory and creamery use,

the slab and lever make a cheap and excellent worker, and one that is durable and easy to clean. The slab and lever do the work as perfectly as any of the more complicated workers I have examined, and cost the least and last the longest ; and hence are in extensive use where large quantities of butter are manufactured. They are made of two-inch white oak, maple, or birch plank, three to six feet long, and two to four feet wide at one end and half as wide at the other. A thicker plank is often used. It stands on three legs, and inclines toward the narrow end, so as to drain off the liquid worked out of the butter, which is conducted down the slope by means of a shallow groove on either side of the plank. A loosely-fitting standard sets in a hole at the middle of the lower end of the plank, resting upon a shoulder, and fastened in place by a pin through the end, which reaches down below the plank. Through a hole in this standard one end of the lever is inserted, and the other is handled by the operator. The working is best done by pressing upon the butter with the lever, which should be four inches through, and which may be square, octagonal, three cornered, round or flat on one side, and round on the other, to suit the fancy of the workman."—*Arnold.*

The above is given more by way of suggestion than as the perfect butter-worker. It will be easily made, and anything in the market similar to it will have, besides its general merits of simplicity and adaptability, the merit of cheapness. With regard to the form of the lever, it may be said, that sharp edges should be avoided in the lever.

Hand Contact.—He condémned the practice of working butter with the hands, as no matter how careful they might be as to cleanliness, there was a danger of its being impregnated with offensive odours. If anyone did not believe this, let him eat an onion without touching it with his hands, and then ascertain if his arm would not give off the odour of onions two hours afterwards.

"So important is this source of contamination regarded in America, that every endeavour is made to get quit of manual labour in working the B., and a wooden *butter-worker* has been invented, and is largely used there."—*Chambers' Ency.*

Mr. Bowditch emphasized this statement : "*First-class butter cannot be made if the human hand touches it ;* and gave as a reason that through the pores of skin there would exude the impurities of the whole system, and the working of butter tended to open the pores of the hands by its moisture and coolness. Besides, the temperature of the body at 90° is too warm to come into contact with the butter. He uses a wooden roller, and works the butter gently as he would bread dough or pie crust; working out all the butter-milk and moisture ; he also uses a fine sponge to bathe it off frequently, to absorb the moisture."

"Hand contact should be avoided as much as possible, especially when the dairymaid has naturally hot clammy hands." . . . . "The butter working or kneading machine is an invaluable implement in any average sized dairy, and if more generally used, would add considerably to the advantage of the dairy farmer, by completely removing those ingredients from the butter, which injures its flavour, etc., besides by thoroughly incorporating the salt enhancing its keeping qualities."—*Prize Essay No. 1, Cork, 1878.*

"Wherever the best butter is wanted they are a great help. There is much saving of labour by their use, and all handling of the butter by the dairymaid in working it, and squeezing out the butter-milk, is avoided. This handling of butter by the dairymaid was never a nice process to think about. . . . Every one who knows anything about dairies has heard of dairymaids who could not make good butter because they had a 'hot hand.'"—*Prize Essay No. 3, Cork, 1878.*

"It has been long considered that a dairymaid with a cold hand was the best for butter-making. But it was not known why a cold hand was the best, except that it was thought the butter remained cooler, and consequently firmer, after it was worked. This, however, is not all. It is well known that carbonic acid is constantly being thrown off from the pores of the skin of the human body, and it is no doubt true that this physiological process is less active in the skin of a cold hand than it is in that of a warm one, and so a cold hand will do less harm than a warm one to the flavour as well as to the firmness of the butter. But in the most advanced butter-making establishments in America and the Continent of Europe the human hand, be it cold or warm, is allowed to come as seldom and as little as possible in contact with the butter. A celebrated German

chemist, whose name is well known in many parts of the world, Dr. Fleischmann, of Raden College, and who has devoted years of practical and scientific study to butter and cheese making, considers that the varying states of health to which the human frame, especially of the gentler sex, is constantly and periodically liable are among the chief causes why butter varies so much in quality of flavour. So in these leading dairies, or factories, or creameries, or whatever we choose to call them, the butter is seldom, if ever, even touched by the hand, and the working of it is done in wooden butter-workers of one kind or another, and the handling by small wooden shovels or spatulæ. This practice is scientifically correct."—*Prof. Sheldon.*

"For working very small quantities a wooden bowl and ladle, or a table and paddle, may do; but for general dairy purposes, where butter is to be packed, a 'butter-worker' is very necessary. The lifting of the butter from the churn, when it is at a cold temperature, is a work so quickly performed that it may, perhaps, be done by the hand without any appreciable harm to the butter; but there is no need of even this much of hand contact; a ladle, a paddle or a strainer dipper is quite convenient, and their use is thoroughly scientific. Not only the wholesomeness of the product, but the health of the operator will carry emphasis to this condition. Dairy women have admitted that they are aware of suffering physical injury from the old way of doing this and other dairy work."—*W. H. Lynch, in Canadian Farmer.*

"In 'working' butter we use a table over which a fluted roller is made to pass, rolling out the butter in a thin sheet, and completely and entirely depriving it of buttermilk."—*Mr. Lincoln, Premium Butter-maker.* (*See Flint, 1860.*)

"Butter-workers" are considered now by best butter-makers as absolutely essential to good results. They make the work easier. They improve quality. By them the grain is preserved, and consequently colour and taste and keeping quality. They provide against taint from the hands, work out the buttermilk, or water, more completely, leave the butter more solid, and salt more evenly.

The Sponge and Cloth.—The use of the sponge, so valuable as an aid to save "overworking," was early appreciated. Mr. Flint, in his book, 1869, quotes Mr. Lincoln, who was a most successful butter-maker: "A large sponge, with a linen cloth to cover it, with which the milk can be removed from the butter, is another important article. . . . . After the butter has been taken from the churn, it is placed upon the table, worked over with the lever and salted; then worked again with the lever, in connection with the sponge and cloth, a pan of cold water being at hand, with a piece of ice in it in summer, into which you throw the cloth and sponge frequently, and wring out dry before again using it. . . . . I would here add that the use of the sponge is one of the important points in making butter to keep well; for by it you can remove almost every particle of butter-milk, which is the great agent in the destruction of its sweetness and solidity." The proper churning and washing of the butter will make the use of the sponge less valuable, because less necessary, but its use is always advantageous.

Purifying Water.

Water.—Must be Pure.—"Nothing but the best and purest water should be used about butter. If the water is hard from the presence of lime, or contains anything that could injure the butter by contact with it, washing becomes an injury instead of a benefit to the keeping. Nothing but the best and purest water should be used about butter. Very hard water is always objectionable. It is not, however, so objectionable as the water from wells, which contain a muddy sediment so full of organic matter as to become tainted. Water standing over such mud takes in the taint, and if used for washing butter, is sure to injure it for long keeping. There is a good deal of well water, otherwise good, which is rendered entirely unfit for using about butter by reason of sediment at the bottom of the well.

"This is frequently the case in dry times . . n wells get low and the influx small, and the water in them is too slowly changed. . once saw a nice lot of butter spoiled entirely for table use in twenty-four hours, by being washed with water from a well which was low, and the sediment in its bottom had become affected. It is not a very

uncommon occurrence to find water in wells, which people do not object to using for culinary purposes, so much affected by sediment as to be detrimental when applied to butter."—*Arnold.*

"Different waters, like different diseases, require different treatment to purify them; and all waters, no matter how impure they may be, can be made quite pure for drinking or other domestic purposes without distillation, provided the proper materials be used, and sufficient time allowed the reagents to act; but in many samples of water I have found distillation to be the quickest and cheapest mode of purifying them. All filters in use that I am aware of only purify the water from solid impurities mechanically suspended in the water. The following is a description of a filter that I have often used, which purifies foul water from organic impurities held in solution as well as from suspended solids. Take any suitable vessel with a perforated false bottom, and cover it with a layer of animal charcoal; on the top of that spread a layer of iron filings, borings or turnings, the finer the better, mixed with charcoal dust; on the top of the filings place a layer of fine clean siliceous sand, and you will have a perfect filter. Allow the foul water to filter slowly through the above filter, and you will produce a remarkably pure drinking water. Before placing the iron filings in the filter they must be well washed in a hot solution of soda or potash, to remove oil and other impurities, then rinse them with clean water; the filings should be mixed with an equal measure of fine charcoal. If the water is very foul it must be allowed to filter very slowly. The deeper the bed of iron filings is the quicker they will act."—*Selected.*

Foul Well Water.—"Sewage water that has had the crude portion of its impurities removed by imperfect filtration, is not only clear and sparkling, but peculiarly pleasant to the taste from the gases and salt which it contains, but it is, nevertheless, the source of some of our most fatal diseases. The only way to remove this poisonous quality is to filter the water either through a thick and dense bed of soil or a thick layer of charcoal; and as it very rarely happens that it is convenient to do this after the water has been drawn from the wells, we out to use every means to keep impure water out."

Impurities in Well-Water.—How to Detect Them.—A case which recently occurred at South Norwalk, Conn., where three persons in one family died in consequence of drinking water from a well tainted by drippings from a cesspool, ought to be a warning to all persons to beware of the typhoid poison, sure to be found in wells near dwellings, if any of the house-drainage can percolate to them. The gelatinous matter often found upon the stones of a well is poison to the human system. Wholesome water is always odourless and colourless. To test its purity thoroughly, place in it a few grains of lump sugar and expose it to the sunlight in a window. Should the water become turbid, even after an exposure of eight or ten days, it is a proof that it has been contaminated by some kind of sewerage. If it remains perfectly clear, it is pure and safe. Such an experiment as this costs nothing to make, and it would be well if all families who have the faintest reason to suspect that their drinking water is impure would take this way to ascertain the truth of the matter, in order that they may provide in time against the insidious and deadly poison contained in all water contaminated with sewerage. The above article, clipped from a Northern newspaper, is of special importance. The writer, on seeing the above suggestion some years since, tested the water from his wells by taking a clear white glass bottle—a Florence oil-flask is best—and placed it with water and sugar in the sunlight, well corked, and soon found the water to become turbid. He then put some pure rain water to the test, and found it to remain unaltered. He immediately sunk two wells at a considerable distance from his house, the last of which stood the test perfectly. In addition to this, he built a large cistern of brick and cement, and has had the satisfaction of knowing that his family are not poisoned by such impurities of water as quite too many of our citizens are now suffering from.—*St. Augustine Press.*

A Satisfactory Filter.—I have a domestic filter which has been in use nearly two years, and answers our family purposes remarkably well. It is simple in construction, and attended with little expense. It consists of a stone jar with an orifice in the bottom, in which is a cork surrounded with sponge to prevent the water from passing out too rapidly. On the bottom of this jar are three quarts of clean sand, on this the same quantity of fine charcoal, and on this a layer of pebble stones. In the top is an ordinary

flower-pot, in the hole of which is a sponge to prevent the water passing out faster than it drips from the jar below. The filter is inclosed in a case, stands near the hydrant in the summer, and in the cellar in the winter. The sponge in the flower-pot should be cleaned once or twice a week, but the sand and charcoal do not require renewing oftener than twice a year. If your correspondent requires further explanations, it will give me pleasure to furnish them.—*New York Tribune.*

How to Make a Well.

"First, of course, the well must be so constructed that it cannot act as a drain for the neighbouring soil. This can be done by making the wall above low-water mark of some material impervious to water, or by omitting this part of the wall altogether. The first can be accomplished by having the wall from a point two or three feet from the bottom made of brick, with a coating of hydraulic cement on its exterior, or of hydraulic well-tubing, with the joinings well protected with cement; in either case, the earth should be thoroughly packed around the wall, and a slight embankment should be made around the orifice to prevent the in-flow of surface or storm water.

"In such a well the draining surface is so reduced, and placed at such a distance below the surface of the ground, that in the great majority of instances, the introduction of foreign matter becomes almost impossible, except in so far as there is a chance that substances will fall into the well from above. To prevent this the well should be kept covered when not in use. In most cases, however, it is better to omit the upper part of the wall altogether. After the excavation is completed, the wall can be built in the usual manner for a distance of two or three feet, more or less, as circumstances may demand; the service pipe can then be placed in position, and the well arched over. The remainder of the excavation can then be filled with earth, well packed as it is thrown in, and the pipe carried to any convenient point. It will be necessary to place above the arch several layers of stone successively smaller, to prevent the falling of earth into the space below.

"The workmen will probably suggest a layer of turf or straw to accomplish this object, but the presence of either of these substances will cause the water to be unpleasant for a considerable time, and will prove the cause of much annoyance.

"There is a prevalent notion that the well should be ventilated for the purpose of allowing noxious gases to escape; and that water is better for being exposed to the air. I hardly need state that the only noxious gases in a well (*i. e.*, gases which render the water unwholesome) are the products of the decomposition of organic matter which has found its way into the well, in ways which have been described above, and that water as it flows in its subterranean passage is more perfectly aërated than it can be in any other way."—*Scribner's Monthly.*

Clean out the Springs.—"The larger part of the pastures of New England are supplied with water by springs from out of the hill-side, or under a big rock. This spring, though flowing an excess of water when the snow is melting, often gets filled or obstructed with leaves or dirt, as the summer advances; and when the drought begins to tell, and the springs get low, with the rubbish in them, the stock cannot get at the water. They get uneasy and break out, simply because they are in search of water. The farmer drives them back, puts up the fence, and perhaps hampers the cattle, never thinking that the lack of water is the cause of all the trouble. Now is the time to clear out these springs. Dig down a little in them, and see that the way of access for the stock is easy."

The dangers arising from the contamination of wells by the drainage of cesspools, is a matter of the most vital importance. The following is an extract from Prof. Orton's Report on the Geology of Greene County, Ohio:—

"The veins, or rather sheets, of water found under ground are derived from no mysterious sources, but receive their supply, in considerable part at least, directly from above. Surface waters traverse the shallow, gravelly clay that covers the rocks, easily and rapidly, and they descend through the porous limestone with almost equal facility. But it is often forgotten that all of the water descends—water from drains and cesspools, as well as from summer showers or winter snows. In point of fact, no more effective drain

is required for the discharge of ordinary household water-waste than an opening into these gravelly clays affords; and when the excavation is carried to the surface of the limestone, the drain discharges its contents with great promptness. The case is bad enough as already stated, but in point of fact, it is even much worse than it is here represented. If the descending sewerage and cesspool water were all obliged to traverse the pourous limestone before entering the veins from which wells and springs are fed, we could be certain that it would be quite thoroughly filtered. But the cap rock is not only porous; it is also fractured. Like all massive limestones, it is traversed by two sets of joints which divide it into blocks of quite regular shape. But partly by solution and partly by contraction and settling the faces of these divisional planes are no longer in contact. Crevices varying from an inch to a foot in width intersect the strata. They are generally filled with gravelly clay, but they allow a very free transmission of liquids from above. A very gross and dangerous communication is thus established between the neglected or polluted surface and the water veins depended on for daily use.

"It has been abundantly demonstrated that drinking water contaminated with even a very minute proportion of undecomposed excretory matter becomes a common carrier of disease. Cholera and typhoid fever, in particular, are known to be very largely distributed in this manner. The addition of one grain of sewerage defilement to the gallon was found, in the cholera epidemic of 1866, in London, to be directly connected with seventy-one per cent. of the whole mortality. The fact that cholera has wrought its worst ravages in this country in places quite similar in geological structure to the areas now under discussion, is well known. The names of Sandusky, of Nashville, of Paris, Kentucky, of Covington, Indiana, will recur to the minds of all. There is weighty reason for believing that the fatality of the disease in all these widely separated points is due to the geological structure which they have in common. The blocky limestones which underlie them all, taken in connection with the arrangements of wells and cesspools that ordinarily prevail, renders not only possible, but in many cases necessary, the defilement of drinking water with the products of disease.

"These limestone wells, in all thickly settled areas, as towns or villages, must be looked upon with grave suspicion. The water which they furnish is very grateful to those who use it, it is true, for it is cool because of the depth from which it comes, and clear because it has been filtered sufficiently enough, at least, to remove all grosser impurities; but despite its clearness and coolness, it may be laden with the germs of the deadliest pestilence. Clear water is not necessarily pure water.

"A word of warning needs to be given in the same connection against the common drift wells of the country. An ordinary well serves a two-fold office—it is a way to water and a draining-pit beside. Because the first office is only regarded in its construction, it is too often forgotten that it must of necessity discharge the latter function. Great care needs to be exercised over the area that can be influenced by this deep excavation. Certainly the drainage of privy-pits, barn-yards, and kitchen-waste ought to be most carefully excluded from the household water supply. Too often water from all of these sources contributes to the contents of wells, and they thus become, in an evil hour, fountains of disease and death."

GENERAL.

SCIENCE IN FARMING.

"Most farmers find themselves engaged in a vocation, whether it be from choice or otherwise, some of them without special education for their work. They have not, as a rule, a professional education for their life work, as have doctors, lawyers, ministers, college professors, and public school teachers. Why should a man expect to be a skilful and successful farmer without some special education for his vocation, any sooner than to be a successful doctor, lawyer, preacher, or teacher without special education for their profession? Self-educated farmers there are, and there are some such present, as there are also of self-educated, professional men, all of whom are exceptions to the general rule. The notion is prevalent in the States, and possibly it may be in the Province of Ontario, that when a man finds he has not education or training that fits him for any other business or vocation he turns farmer, and is always foremost among those who say 'Farming don't pay.' No wonder, is it? The marvel would be if it were otherwise with such men."—*Prof. Wetherell, Brockville, 1883.*

Traditional Farming.

"Perhaps there is no business or vocation of man more emphatically traditional than that of farming. All who are thus engaged call themselves 'practical men,' knowing nothing of the doctrines and principles which underlie profitable farming; nevertheless, they boast of being 'practical men,' and at the same time ignoring theoretical scientific doctrines and teachings as unprofitable, which some of them feign to neglect and despise, calling those who heed and study such perceptive instructions of practical wisdom, 'book farmers.' Such men are, however, properly speaking, workmen who employ themselves according to a traditional routine. The man who farms by traditional recipe, like the wife who cooks by recipe, being meanwhile ignorant of the principles involved, is sure from the lack of the necessary knowledge and exercise of judgment to experience many failures, to put it no stronger."—*Prof Wetherell, Brockville, 1883.*

Theory and Practice.

Theory.

"The word theory in art or science is the expression for the connection of the natural laws or conditions by whose co-operation certain results are produced or effected, and is called the theory of the thing done; in other words, the process of doing it. The word theory, as here used, has no other meaning, and therefore cannot be regarded as the synonym of hypothesis, guess, or opinion. It implies knowledge necessary to explain a phenomenon, or what has been, or is to be done.

"The word theory is often employed by writers and speakers in the loose sense of hypothesis, conjecture, think, opinion, reckon, terms which signify the lack of knowledge.

"Practice is the method or art of doing anything—as the exercise of any special art, vocation, or profession. There is a distinction, but no opposition, between theory and practice; each, to a certain extent, supposes the other; theory is dependent on practice, but practice must precede theory. Practice is the exercise of an art, or the application of a science, which application is itself an art. Hence, a person evincing practice or skill therein toward some useful or desirable end, is rightly termed a practical man.

"Experiment is another word in popular use among farmers, which needs be better understood than is ordinarily the case among those who frequently use it without seem-

ing to comprehend its significancy. Experiment is defined as a trial or operation for the purpose of discovering the unknown; a trial either to disprove or confirm something deemed doubtful. Baron Von Liebig said an experiment, whether it succeed or fail, is, considered by itself, a fact only, which explains nothing unless its success or failure be brought into connection with the laws or conditions by whose operations the result was determined. Sound practice and true science are always in union; and a contest or wrangle between two persons concerning such matters is possible only between persons, one of whom does not understand the other, provided either apprehends the matter in dispute. The chief difficulty will generally be found in the want of precision in defining things, and therefore in employing indefinite, vague language to express what is meant.

"Theory is the general term applied to the exposition of the connection of natural laws, named as follows:—That the atmosphere possesses weight, that pressure or fluids is propagated uniformly in all directions, and that pressure acting in one direction without counter-pressure produces a motion which continues until equilibrium be restored. The man of theory, and he was a chemist, who predicted the effects of guano had not seen the favourable results of its application, which 'nitrogen champions' subsequently had occasion to observe in Fatherland; but the prediction of its utility had been based on the results of its chemical analysis, and was therefore only a corollary deduced from the principle that it is indispensable to restore to the field, exhausted by the growth of grain, the mineral elements removed by the crops taken therefrom.

"Guided by the study of the elements of plant-food, science forty years ago pointed out guano as one of the most infallible means of increasing the grain crop in England, and urgently recommended its importation. Before 1840 guano was then unknown in European agriculture. When the first vessel loaded with it arrived in Liverpool, numerous experiments were made with it by farmers, which proved failures; accordingly, agriculturists disagreed as to its utility until its use had been practically and experimentally tested. Since this was done, hundreds of ships have been freighted with it for Great Britain and the European continent, said Liebig twenty years ago, at a cost of £25,000,000; and within the same period of some twenty years a surplus of more than 400,000,000 cwt. of corn, or its equivalent in flesh, have been produced. So much for the confirmation of the theory of practice with science.

"Whatever practical agriculturists and agricultural societies or conventions may do, whatever they may resolve at their annual meetings, every dollar will be thrown away and every year of experimenting will be in vain, so long as self-styled 'practical men' will not submit to the teachings of science confirmed by practical experience, to the rules of logic and common sense; from the time they submit, science will be their co-worker. Scientific principles introduced by chemistry into practical agriculture are very simple, and the demands made upon practical husbandmen and to their own advantage, that, to an unprejudiced person, their opposition seems incomprehensible.

"What practical men want is knowledge, and they are agreed in this one point, that they will not alter their practice on account of what they deem an undemonstrated hypothesis, however probable it may seem, until they are convinced of its truth by demonstration, when, of course, opposition is at an end. This position is defended for the reason that farmers have so often been misled by prating pretenders, charlatans, quacks, and mountebanks engaged in peddling recipes, agricultural and horticultural, to eke out for themselves a subsistence. As in the days of the farmer and grazier of Uz, so even down to the present time, whenever farmers meet for conference there are such adversaries as in the days of the man of Uz. Hence, good reasons why 'practical men' have learned to wait in case of new-fangled notions, retailed by charlatans, whether seeds or fruit trees, before investing in them. Such, however, are not good reasons for objecting to science and common sense."—*Prof. Wetherell, Brockville, 1883.*

Practice.

"The ignorant, practical farmer is impressed, and therefore assumes that all farms are in the same general condition as his, and therefore the same system which answers on his farm will do so equally well on all other farms; that the manure which he finds useful

may be equally useful on all others; that the deficiencies of his fields are the same in respect to all others; that what he exports others export, and what he needs do to restore his soil to fertility, all need do the same; yet he really knows nothing of the real condition of his own farm while attempting to persuade others that they need only do as he does to be good and successful farmers.

"The theory and practice of stocking a farm in respect to cattle, sheep, horses, hogs, hens, turkeys, geese, and ducks, called the live stock of the farm, present many and highly important topics of inquiry which farmers are anxious to have answered."—*Prof. Wetherell, Brockville, 1883.*

GOVERNMENT AID.

"I wish to endorse the words of Mr. Lewis with regard to the generosity of your Government, so far as its most liberal treatment of the agricultural interests is concerned. Our Government has done very little in this direction. I hope that the liberal policy of your Provincial Government will be continued and increased rather than diminished. I am sure it will be found that the funds will be repaid back into the treasury many fold. You have got good farms and enterprising men in the Province, and a first-class Dairymen's Association; and I am sure your farmers will not be slow to catch hold of the salient points of what is said, and use them to their advantage."—*Prof. Wetherell, Brockville, 1883.*

"For the deplorable condition of the art of butter-making in Canada there are many remedies proposed. 'Improved stock,' 'better feed,' 'creameries,' 'butter factories,' 'dairy schools,' 'inspection,' 'grading'—each remedy is put forward with the same exclusiveness that characterizes the diagnosis of the trouble. Some are ready to pronounce the case hopeless, and to ridicule or discourage all efforts to help the matter. There is doubtless merit in every position taken except the latter. Deliver us from the pessimist. There is always some remedy. One remedy lies in following the example of other countries which have been grappling with the same question. Let us look to Denmark, which exports butter to countries so far not open to us. Denmark teaches us two things:—(1) The benefit of Government encouragement; (2) one way in which Government may direct its efforts.

"Mr. Barre, one of the Dairy Professors for the Province of Quebec, states that thirty years ago dairying in Denmark was not so advanced as it now is with us:—'At that time Denmark exported very little butter, and its dairy products ranked in the European markets below those of Ireland, France, Holland, and even Germany.' 'Denmark now holds first place amongst the dairy-farming countries of Europe, and, in so far as relates to the manufacture of butter, is in a position to teach every country in the world.' .This was all attained by the Danish Government giving special aid to the industry First, young girls were educated in butter-making by grants from the Royal Agricultural Society. Agricultural Colleges were established, and, later, men of scientific attainments were engaged to make a special study of milk and its practical uses. Lastly, the work was extended, and efforts made to encourage everything which might be beneficial to dairying—exhibitions, lectures, etc. An important consideration in the working of this reform in Denmark was (1) the cost of the work, and (2) the slowness of the change.

"The Danish Government, according to Mr. Barre's report, 'has given, since 1858, to the various (agricultural) institutions and to its scientific men ten thousand dollars per annum, for the sole purpose of encouraging scientific researches and the study of the manufacture of dairy produce, particularly butter.' It is claimed further, that 'the State, and many public and private establishments have contributed to the development of dairying. Numerous local agricultural societies in all parts of the country, as well as private individuals, have generously given their assistance to the common task.'

"It has taken nearly half a century to accomplish what has been done. It was in 1836 that 'the Royal Agricultural Society of Denmark first took steps to encourage young girls who wished to work at dairying.' So long ago as 1858, 'theoretical instruction was supplied by establishing, at the Royal College of Agriculture, a class in dairying and by appointing a professor for this special branch.' It appears that the main advance has been since that time.

"All this goes to show that we have in Denmark an example of a profitable application of public funds for the improvement of what was there, as it is here, an important industry in a deplorable condition. But we are taught that we must not expect that, by following the example of Denmark, the improvement will come in a day, or a year, or perhaps even in ten years. It may not take so long as it did in Denmark to bring the change about, since we can profit, without much cost, by the experience of that country. Even if we change in half the length of time it will take many years. If we are impatient and desire an earlier change, we must improve upon the Danish plan of helping the industry.

"We have said the Danish policy is to teach the principles of dairying. A part of the system is to place students at the different best kept farms selected for the purpose. In these 'elementary agricultural schools' both theory and practice is taught, but the teaching is of a lower standard. 'It is to this teaching that Denmark owes its prosperity and the progress of its dairy industry.' The end is attained by turning out skilled operatives. 'To arrive at such a result the students must be kept hard at work all the time (for twelve or fifteen months); they must repeat the same operation a hundred times, until they have attained the desired perfection in its performance.' This is a slow process. About a hundred students each year are put through this course, 'many of them from Denmark (where the teaching is done), but more of them from other countries.' The result is that the average skill of the country is yearly raised, but only gradually and very slowly, while other countries profit largely by the work.

"There is proposed a plan of improving the dairy industry of this country which has some practical features quite different from the Danish system. It was recommended by the Executive Committee of the Dairy Association of the Province of Quebec, and strongly recommended by the Quebec Legislative Assembly upon a resolution of the Committee of Agriculture. It is the project of placing, through the Council of Agriculture, in each county, and, if possible, in each district or parish, a complete outfit for the manufacture of butter, accompanied by a lecture on butter-making, and a practical demonstration of the art. The main advantage this has over the Danish plan is that skill on the part of the operator, while desirable, is not an absolute essential. It is recognized in this system that butter-making is a purely mechanical operation, and made easy or difficult largely by the use respectively of suitable or unsuitable appliances. It had been demonstrated to the satisfaction of the various leading men who had the matter brought officially before them, that an advance had been made in this line among ourselves that would warrant the expectation of success.

"The knowledge of dairying and the skill already possessed by our butter-makers is sufficient to ensure good results in the use of proper appliances which, in a simple way, themselves carry instructions, and correct faults.

"There are several advantages in the second method over the Danish plan that may well be noted. First, the cost to Government will be less. Second, the cost to the individual will be less. Third, the result will be a greater improvement. Fourth, the improvement will be much more quickly brought about."—*W. H. Lynch, in Toronto Globe, June, 1883.*

"I will state what took place in Denmark, particularly as to the improvement of dairying. If I understand rightly, Denmark was lower in the quality of her dairy produce than any other continental country. Their butter was sent to the English market, but it was considered the poorest in that market. Gentlemen of science, and owners of the soil thought it was too bad that with a good climate and fair soil, with an abundance of water, that this should be so, consequently they put their heads together and began just where you began sixteen years ago, to find out how the produce of the country could be improved, but found the task too much for their means and time. But bye-and-bye they called upon the Government to make an enquiry to see how much the country was losing by this poor butter. As a consequence European talent was paid the very highest prices in Denmark, and in return the highest prices have been paid for the products of their dairies there. The Government can do more, a great deal, than individuals. There is no question in my mind that if we would apply the experience of Denmark and other countries in Europe, that in not many years we would have millions of dollars to our

credit and in the pockets of the farmers. The general trade of the country would improve, too, in the same ratio, but the farmers would be the ones most benefited. What I believe we want in Ontario, and also in Quebec, is union of the best talent and science, and by these obtain from our dairy produce the very best results. I think I am not wrong when I say that the Danish Royal Agricultural School cost the Government over $10,000, and now all other countries are sending students over there to see and learn what is to be seen and taught there."—*Prof. Barnard, Ingersoll, 1883.*

"We have now to notice one other factor in the realized improvement of the cheese industry, as a factor in the desired improvement in the butter industry. It is that of Government aid. Most Governments have committed themselves in some measure to the policy of improving the dairy as well as other agricultural interests. The Quebec Government has established a sort of dairy school, and intimated its intention to do more. Ontario has been stimulated to take some action, and has avowed a policy of giving any assistance that will be likely to help the dairy industry.

"In what way can Government, with the least outlay, give the most help?

"In a recent editorial in the Toronto *World* reference was made to a letter from Mr. J. Kennedy to the Hon. O. Mowat. Mr. Kennedy stated that the present quality of Swedish butter holds first place in the English market, and is valued at from four to eight cents above Canadian creamery; that the quality of Swedish butter is owing to the establishment, in 1868, of schools for the training of dairymaids; and that Government should do likewise here. The suggestion seems a most natural and reasonable one, but too much must not be expected from the means proposed. The Swedish people, before 1868, were noted for some charactertics favourable to butter-making. They were cleanly and neat, and methodical in habit. Yet the Swedish Government has expended a comparatively large amount, and it has taken a long time to bring up the quality of the butter product of Sweden to its present standard. It is worthy of consideration whether or not the result may be attained in some other way more speedily and even by a less outlay. We have already seen that the utensils used are an important factor in the work. The facts gathered from the history of dairying, where improvement has been made, emphasizes the importance of this factor. Professor Sheldon writes of continental dairying as follows:—'They study the principles of their art, which are propounded to them by scientific teachers,' and 'they follow out the most approved systems and adopt the most modern utensils.' Government cannot but recognize at the outset that there is a need of the adoption of better utensils. Only a few dairies are supplied with the 'best modern utensils,' and the few dairies that are better fitted up than is the rule, instead of being supplied with complete and uniform outfits, are supplied by articles picked up in different places, and in some cases, as a matter of fact, purchased in the States. Abstract teaching in Dairy Colleges will be a slow process. On the other hand, the introduction and use of suitable appliances will carry instruction and induce a change of method in each home dairy. The difference between hand-sewing as it was and machine-sewing as it is, is not less than the difference between the primitive butter-making that is and scientific butter making that should be. The introduction of sewing machines and the revolutionary change thus brought about is an illustration of what may be done in other industries, in even that of butter-making. It would seem that Government aid would be most economically and effectively given by recognizing the importance of the other factor in the desired improvement. It is for private enterprise or capital to do one part of the work: it belongs to Government to do the other, or purely educational part of the work. The need of educational work to be done makes capital timid about taking hold of its part of the work. Let the Government policy be to encourage such investment of capital as will be calculated to forward the work. There would be in this nothing inconsistent with the general policy of Government. Any help given would be to encourage what, owing to this very need of education, is bound to be a 'struggling industry.' By encouraging such an effort the Government would do the most, at the least cost, to forward its own purpose. After the first lift given to the industry, Government would leave the work to be completed by private enterprise."—*Monetary Times, 1883.*

Farming for Profit.

In a book called "Farming for Profit" are some good points for the general farmer, some of which find an appropriate place in these pages.

The following is a strong argument for mixed farming, and for producing as much as possible on the farm of what is consumed on the farm, all of which is consistent with making dairying a specialty :—

Farming Specialties Unprofitable.

"Twenty years ago the farmers in the Connecticut Valley were doing a small but a reasonably profitable business. They cultivated a variety of crops, produced on their own farms a large part of their household necessities, and had no debts which they could not pay. But in an evil hour some venturesome spirits found that tobacco would pay a large profit. The price advanced rapidly, the demand increased, and a multitude of farmers who had been in the habit of growing corn, potatoes and hay, turned their attention to the culture of this crop. Like the tulip mania which in olden time well-nigh ruined the staid old inhabitants of Holland, this tobacco mania seemed to fairly possess the souls of men who had been regarded as wise counsellors and worthy examples. Young men thought they saw the way to fortune very clearly marked out, and bought land for the culture and put up buildings for the curing of tobacco, going into debt for both land and buildings with a recklessness almost sublime. Land rapidly advanced in price. In some sections land which was barely worth one hundred dollars was sold for five hundred dollars per acre. Men seemed to think that by making a specialty of tobacco they could afford to pay almost any price for land.

"Not only did they buy land at fearfully inflated prices, but they bought almost everything else. They had but little money, and soon were deeply in debt; but by growing tobacco they expected to make money enough to pay for everything which they wanted to buy. Those were golden days for dealers in sewing machines, parlour organs and pianos. Sales could be easily effected at prices which were highly satisfactory to the agents and their employers.

"The idea also became firmly fixed in a great many minds that the tobacco-grower could buy all the ordinary farm-products cheaper than he could grow them. Many a farmer, who in former times had made money in growing corn for half what was then its selling price, was convinced that it would not pay him to grow corn, for he could buy it for less than the actual cost of cultivation. The same reasoning was applied to almost all of the other old-fashioned crops. As the inevitable result of such a course, farmers not only had nothing but tobacco to sell, but, far worse than this, they were constantly obliged to buy things which they had formerly grown at home. After a few years the farms began to show an unmistakable decline. The few acres which had been devoted to tobacco, and to which large quantities of fertilizers had been applied, were in fine condition, but all the rest of the farm had been robbed in order to make the tobacco fields rich enough to produce a good crop.

"Still farmers seemed to have implicit faith in the future of tobacco, and though their debts remained unpaid, and their bills at the village store were daily increasing in amount, they were not alarmed. Once a year they sold their tobacco. For a few days they had considerable money. But when the store bills were settled, and the interest on their borrowed money was paid, they were, in a financial point of view, pretty well reduced. In a short time the old credit system was again adopted. They bought freely, promising to pay when they sold their tobacco. Large quantities of fertilizers were bought to be paid for when the crop to which they were applied was ripe and sold. Sound business principles seemed to be forgotten by buyer and seller alike. All parties who were engaged in the business failed to see that tobacco-growing not only possessed all the weakness which is inherent in the one-crop system, but certain elements of danger not necessarily connected with the growing of a specialty. But in time their eyes were opened. When it was too late their mistake became evident.

"Tobacco proved to be a very uncertain crop. In good seasons, when the land was of a suitable nature and was well prepared, there was no great difficulty in securing a

good yield. But some seasons were not favourable, and the crop did not do well. One summer an untimely hail-storm utterly destroyed the whole crop for many farmers who had made it their chief reliance for the support of their families for a year. Some seasons drought seriously injured it; at other times the tobacco-worm was terribly destructive; and when these evils were avoided or overcome, others seemed to be ready to carry on the ruinous work.

"Then, too, when the growth of the crop was all that could be desired, the curing process was not always safely accomplished. In some cases, after the cost of growing and harvesting had been sustained, a defect in the curing almost ruined the product. After a while a time came when the demand for tobacco ceased. Unlike corn, or wheat, or many other crops which are sometimes grown as specialties, this product could not be consumed at home. For all practical purposes it was wholly worthless. Until it would sell it was good for nothing. Prices rapidly went down, and the dream of the tobacco-grower came to an end. Many farmers found debts pressing heavily upon them with no means of payment. 'Hard times' came on, and property depreciated rapidly in value until it came to a point where prices were merely nominal. Some of those who had done the largest business and been considered wealthy men went through bankruptcy, and paid but a few cents on a dollar. Others compromised with their creditors, while some sanguine men attempted to pull through. Like the growth of Jonah's gourd, the prosperity of this industry was sudden and brilliant; while, like the decay of that vine, whose history will be immortal, its failure was sudden, unexpected and complete. It was a terrible revelation, but it came with all the force of solemn truth.

"Perhaps some reader will be inclined to assert that all this loss and evil was due to the peculiar times and the extraordinary circumstances by which these men were surrounded rather than to their devotion to a special line of farming. But this suggestion is shown to be wholly at fault by the fact that, scattered through the various towns in which this tobacco mania raged, were many farmers who did not deviate from their old style of managing business, and who have gone straight through these troublous times without financial embarrassment, whose work has paid them well, and who are now regarded as successful farmers by men who, a few years ago, thought them 'old fogies,' and were sure that they were lacking in enterprise as well as in judgment. The test has been very severe, and the lesson is well worth remembering. Let no one think that fancy has heightened the colours of this sketch of the tobacco interest. We have lived in the midst of the excitement, and have seen the results. We know whereof we do affirm, when we assert that the making of tobacco a specialty was a ruinous experiment. Yet many things were favourable for its cultivation. A very fine quality of leaf was secured, and when tobacco was in demand this grade sold for a high price. Probably some tobacco might have been grown without involving pecuniary loss. Merely from a financial standpoint it might have paid well. The trouble was chiefly caused by making its production a specialty. And trouble of like nature, though of less extent, will be liable to come to farmers who engage in any specialty to the exclusion of all other productions.

"The idea, advocated by the specialist, that the man who gives his whole time and attention to the production of a single crop can grow that crop to better advantage than he could if he gave it only part of his time and attention, is undoubtedly correct. The weak place in the argument is to be found in the fact that when this crop is grown the owner has only one product on hand while he needs many. For him to obtain these products is not merely a matter of convenience, it is a case of necessity. Then, too, the specialists have an idea that certain crops can be bought cheaper than they can be raised, and they bring this reasoning to bear upon almost every crop which the farmer can grow. They seem to think that they can prove by figures that each and every farm-crop costs more to produce than it sells for in market. That this is false reasoning is abundantly proved by the fact that the average farmer supports a family and pays taxes without running into debt.

"If the theory of the specialists were true, the harder they worked, the more money the farmers who grow the ordinary crops would lose. It is not uncommon to hear farmers in the older States assert that it costs a dollar a bushel to grow Indian corn,

while it can be bought for sixty-five cents, and to reason from this that a farmer had better not try to grow this crop. That there is a mistake in their figures is proved by the fact that our most successful farmers are corn-growers. If any other crop is taken as an example, men will be found in every farming community who will assert that its selling price is far below its real cost. It is generally impossible to convince these men by taking a singe crop for an example, but even they can see that the farmer cannot buy *everything* which he uses. Unless he cultivates some crop which he can either sell or use he will speedily find his way to the poor-house. As a general rule, the nearer he can come to supplying his own wants the more successful the farmer will be."

Home Production Profitable.

"Of all the facts which have a direct bearing upon the business of the farmer, few are more clearly set forth by the experience of the past than that, as a rule applicable to all sections, home production of articles needed for home consumption is the surest way in which to win success. Where one man has succeeded in the cultivation of special crops, probably ten men have been successful in following a course of mixed husbandry. The latter run much less risk and average much higher profits than the former. In times of general business depression the man who produces a large proportion of his own household necessities has an immense advantage over his neighbour who grows but a few crops and is obliged to buy nearly everything which is used in his family. At such times the difference between the results obtained by these methods appears greater than it does when all kinds of business are good, but at all times the man who is obliged to buy but little, even though he has but little to sell, is the one who is on the direct road to success."

"We think there is a very strong tendency in all parts of the country to abandon all exclusive specialties and adopt a system of diversified farming, and we are glad to note that many of the leading agricultural journals strongly favour this change. In some sections it is becoming almost a necessity for the farmer to increase the number and variety of his crops. The specialties which have long been almost exclusively grown have nearly exhausted the soil of the particular elements of which they are composed, and the crops which are now secured are small and rapidly becoming unprofitable. A system of rotation of crops will give a great deal of aid in restoring the fertility of the land and increasing the quantity of its productions.

"Not only does home production secure a fair reward for his labour, but it also insures to the farmer a good degree of independence. This is an important element and must never be omitted from the account when the profits of various methods of farming are under consideration. The farmer who is doing a large business in one direction and attempting nothing else is not as independent as the one who does much less but grows many different crops. At first glance it may seem as if this division of his energies would be a ruinous thing, but closer inspection will prove it to be very beneficial.

"In order that our meaning may be clear, we will suppose two cases. The first is that of a farmer who makes wheat-growing a specialty. As far as farming is concerned, his whole attention is devoted to the production of this one crop. He strives to grow it as cheaply as possible, and bends all his energies to the accomplishment of this one aim. He is an intelligent man and is reasonably successful in his endeavour. He grows a large quantity of good wheat and has no difficulty in selling it when there is a call for this kind of grain. Occasionally, when the prices are very low, he holds on for an advance. As a general rule this does not prove a good method, and he usually sells for the market rates. In order to grow as large a quantity as he desires he is obliged to keep several horses and a few hired men. Both the horses and the men must be fed, but neither of them can subsist on wheat alone. Meal must be bought for the team and many articles for the men. Even hay is purchased by some farmers who are engaged in growing specialties.

"While the income from the sale of the large lot of wheat is considerable, it is secured at a great disadvantage. The soil, as already shown, will either be rapidly exhausted of some of the most valuable mineral elements of plant-food, or else these elements must

be furnished by the owner at a great and constant expense. It makes a great difference with the profit of the crop whether the manure which is needed for its growth can be obtained from the farm, without any direct expense, or must be purchased at high prices and paid for in cash. If a man is obliged to pay several hundred dollars every year for fertilizers, it will not only reduce the profits of his business, but, in a few years this money with the accumulated interest will amount to a large sum. In order to return this money with interest, and over and above these items pay for the labour which is performed, interest and taxes on the land and other capital invested, and keep this capital unimpaired besides paying the other and inevitable costs of production, the wheat crop must return a very large sum. After deducting these items many wheat-growers would have but little if any money left.

"But when this crop is made the only reliance, the farmer and his family must be supported from its proceeds. It should return enough not only to pay all the expenses of its production, but also to keep the family in comfort for at least a year. This is not all. On a farm managed in this manner the labour is performed at a great disadvantage. Much of the time both of men and teams are comparatively idle. There is nothing which can be done for the wheat, and there is nothing else to do anything for. But the pay of the men and the expense of keeping the teams go on without reduction.

"When time for work comes the labour is very hard and exacting, but it must receive prompt attention or else great loss will result. This way of working is not as conducive to health as the slower and steadier methods of toil which are followed where many different crops are grown.

"Again, in selling the wheat crop and buying family supplies there is quite a percentage of loss which it is usually impossible to avoid. This will appear when we reflect that the wheat which the farmer disposes of to the dealer is sold for the lowest wholesale rates. Every man through whose hands it passes charges a profit thereon, and by the time it reaches the consumer the price is much higher than the farmer was able to obtain.

"The same principle governs the sale of all other products. Consequently, while the farmer sells his wheat at the very lowest market quotations, when he comes to buy the products of other farms he becomes a consumer, and is obliged to go to the other end of the scale and pay the high retail rates. Had he produced these things himself, he could have had them all at wholesale prices, but in preferring to grow wheat with which to pay for them he loses the difference between these two extremes. This is a matter of no small importance. It costs a great deal to support a family when the purchases of supplies are all economically made, and the average farmer has no money to waste or to lose in unprofitable exchanges. With the present styles of living and dressing there will be a necessity for as much buying as the farmer ought to do if he produces all that he can at home.

"Let us now consider the method adopted by the farmer who believes in home production. He does not devote his whole attention to the culture of any particular crop, but endeavours to grow many kinds and grow them well. He desires to obtain a good grass crop, at a cost not exceeding its real value. To secure this he keeps a good stock of cattle to which the hay is fed. The manure from these cattle is applied to the various cultivated crops, and much of it remains to enrich the soil and produce grass after the crops to which it was originally applied have been removed. Good wheat is succeeded by good grass, which remains productive for several years. As milk and butter are wanted for family use, a few good cows are kept to furnish a supply. Corn is grown for the purpose of feeding the hogs and for fattening the beef which is needed in the family. Oats are frequently wanted for horses and young stock, and are produced on the farm. Either wheat or rye, and in many cases both, find a place in sufficient quantity to furnish the family with bread. Roots and vegetables are also grown in abundance, and poultry is kept to furnish eggs and meat. In short, almost every vegetable and animal production which the farmer needs and can grow is given a place on his farm. This adds considerably to his work, it is true, but it also greatly reduces the household expenses. The farm, as a whole, is kept in much better condition and at a much less expense than is usually done under the one-crop system, and much of the extra work which is required is done at those times in which both men and teams would otherwise be unemployed.

"By this system many of the wants of the farmer and his family are not only supplied, but there is often a surplus of the various products which can be exchanged for articles which cannot be produced on the farm. Eggs can be exchanged for tea and coffee, and butter can be made to pay for many of the little things which the grocer must furnish. Poultry can be exchanged for other meat, if desired, and vegetables are often given in payment for other classes of goods. Thus, instead of being obliged to sell all that he grows and pay cash for all that he buys, the farmer can exchange many of his products for things that he needs. Of course, these products cost him something, but they do not, at least do not need to, cost him as much as he receives for them. Thus there is a direct profit on the articles which he exchanges as well as a saving in furnishing these things instead of money. Take the hens for an illustration: It costs something to keep them, but if they are properly managed this cost is considerably below their selling price. Then, too, the hens pick up a great deal of material which they can utilize, yet which, but for them would be wholly wasted. The production of sugar on the farm is another good illustration of the profits of home growing of all the household necessities that the farm can supply. If the farmer attempts nothing of this kind he is obliged to pay quite a sum every year, often several dollars every month, for sugar and molasses. But if he has a maple orchard, or, where this is impossible, grows sorgo, or the sugar-cane, he can obtain nearly all of these materials, which he will need, for a very small outlay in money. Some labour will be required, but it will be labour which is well rewarded. If either sugar-cane or sorgo is grown and the business of the farmer is not large enough to warrant the purchase of a mill, there can generally be found neighbours enough to club together and buy one to be used in common, or else some one in the vicinity already possessing a mill will work up the cane for a share of the product. In either of these ways, one of which will be found feasible in all sections where either the Sugar (Ribbon) Cane or Sorgo can be grown, the home production of sugar can be made very profitable, while the manufacture of sugar and syrup from the sap of the Maple tree requires so small an investment that any farmer who has a good sugar orchard can easily obtain the few and simple implements which he will need for making it productive.

"Other illustrations might be given, but enough has been said to show the far greater degree of independence of the farmer who attempts to supply his household wants, than can be enjoyed by the one who makes a specialty of a single crop, and gives all his time and skill to its production. But this chapter ought not to close without calling attention to the great risk which the specialist is constantly obliged to run. If his hopes are all centred on the wheat crop, and all of his income, as well as all the material for supplying his household necessities must come from this one product, and for any reason wheat proves a failure his loss is very heavy. We all know that wheat sometimes fails to produce a paying crop, and that other grains are subject to similar risks. From this we should infer that farmers would much rather grow several crops than to stake everything upon a single one.

"If a man grows wheat, and corn, and oats, and potatoes, there is no probability that the season will be so unfavourable as to destroy all of these crops. The wheat may be injured, and the other crops saved. Or one or two of the other crops may suffer, and the remaining ones still do well. This matter of comparative safety is a very important one to all farmers of limited means. A wealthy farmer does not like to lose all the crops of a whole season, but he will not be wholly ruined by such a loss. The poor man, however, who has all that he can well do to keep along when things go reasonably well, cannotafford to take any extra risks. With him safety and certainty should be the principal conditions and recommendations to be required in the selection of his crops. The man who follows this course will not handle as much money as the specialist will obtain in favourable seasons, but he will have much more comfort and less anxiety, and will be very likely to find more real profit when he balances his books for the year, than the man who has grown only one crop can show. For it is not, by any means, the amount of money which men receive which makes them rich, but the amount which they are able to save, and a small business which is properly managed, and in conducting which but few expenses are involved, will often pay much better than a large one in which the expenditures are both large and constant. The old proverb, "a penny saved is a penny earned,"

has a great deal of truth in a very small compass. If by growing an acre of wheat the farmer can save the payment of twenty dollars for flour which his family needs, he has really secured as much as though he had earned that amount of money, and then exchanged it for flour. This principle has a wide range of application, and should always be remembered by the man who desires to be a successful farmer.

"Not only does the general principle of home production seem to be a safe and desirable one for the farmer to follow, but the tendencies of the present time, and the condition of the soil in large sections of the country, both point to its adoption as far preferable to any other plan of cultivation which has yet been tested. It is not as easy to obtain money now as it was a few years ago, but the great necessities of food and clothing are in just as good demand, and are just as truly required as they ever were. That they always will be needed is evident, and it also seems clear that the man who labours to supply them, as far as possible directly from his own farm, is taking the wisest course which he can pursue. The worn out tobacco lands of Virginia, the exhausted cotton-fields of the Southern States, the rapidly decreasing yield of the great wheat-fields of the West, and the exhausted rye-fields of New England, all seem to demand a system of diversified farming which shall check this ruinous exhaustion of the soil, and at the same time secure to the husbandman a higher reward for his labour, and a greater certainty of success in his business than the present methods enable him to obtain."

The foregoing has been given not to warn farmers against all specialties, but to put into favourable contrast at least one specialty, that of dairying. It will be noticed that all the arguments against most specialties do not apply to that of dairying. Dairying, even as a specialty, in this country need not mean that the farmer does not produce general crops, at least for home consumption; it involves, rather, a sort of mixed farming, the keeping and feeding of stock, the improvement, not deterioration of worn-out lands. The arguments, that one crop depended upon entirely may sometimes prove a season of failure complete, will not apply to dairying. The precaution of always growing a few acres of fodder crops is a good one, any year, and that precaution provides against seasons unfavourable for pasturing. Even when low prices obtain, there is always return sufficient to give the farmer a living profit; and the evils of over-production are very fairly met by *quality*, a something that should be an *essential* in the economy of every intelligent farmer. Against *cheese*-dairying alone, as a specialty, there are arguments of any weight. Cheese production, exclusively, does not allow of feeding stock and so keeping up the fertility of the soil. Cheese-dairying, therefore, if followed too exclusively, may not always turn to profit and advantage, If there are any objections to dairying as a specialty, there are greater ones to other specialties, to wheat or rye growing, for instance, to cotton production, and still greater to such exhausting processes as tobacco-raising.

Quality the Remedy for Over-production.

"Over-production is one of the great evils with which the farmers of the present day are often obliged to contend. It is an evil which it is somewhat difficult to modify, and still more difficult to remove. Owing to their great numbers, the want, if not the impossibility, of close organization, the wide differences in the soil and climate, and the constant fluctuations in the demands of both the local and the foreign markets, together with the fact that they are scattered over a vast area, the farmers are, more than any other class, exposed to losses from over-production.

"In order to modify, and if possible prevent, the evils resulting from over-production, a wise selection of crops should be made. The farmer must decide for himself which crops shall be grown, and the quantities in which they shall be produced. But his judgment should be based upon sound and extensive knowledge. He should take the papers which give accurate market reports, and should carefully study the figures which they present. He ought to be informed concerning the crop prospects, and in regard to any extensive changes which may be going on in different sections of the country. But he should not often change his crops in hope of securing those which sell for the highest rates.

"There are many farmers continually changing crops in order to obtain high prices. This would be bad, even if the desired rates were secured. But it generally happens that those who rush after the spoils are a little too late. They increase the supply to such a degree that the price goes extremely low. Meanwhile some other crop, the culture of which has been abandoned by many farmers for that of the one which was selling high, becomes scarce, the price rises, and another change is made. Then there are a few years in which the crop which the changing ones left sells well, while the one which they have selected follows the course of all such crops when the supply largely exceeds the demand, and the price runs down below a paying figure. In this way some farmers are constantly going the rounds, always a little too late to get the highest prices, and holding on long enough to sell for the very lowest ones. This is a ruinous course. The farmer has to sell his crops for less than they are worth. The constant changing prevents the following of any suitable system of rotation, and the cost of production is largely increased. Of course, there may be circumstances in which it will be best to change the ordinary rotation of crops. But frequent changes which are made to gain the benefit of high prices are very unprofitable.

"How shall the farmer protect himself from the evils which, often in spite of his individual action, over-production threatens to bring upon him? We know of but one method which promises to be effectual. That is by furnishing only the best grade of articles. It is said that when Daniel Webster was a young man and thinking of studying law, some friend asked him if the legal profession was not already crowded. He replied that it was, but added the significant remark, "there is room enough at the top." He worked his way to the top, and became a brilliant lawyer. While inferior men, or men who had made a poorer use of their abilities, had small fees and but little to do, Mr. Webster was liberally paid and had all the business to which he could attend. This principle will be just as powerful an aid on the farm as it was in the law office. The best farmer will be successful. The man who has the finest wheat in the country can sell it even though multitudes of growers who have only a poor grade are obliged to wait long for a buyer. Even in a time of the greatest plenty farm productions which are strictly first-class will sell. They may not command as high prices as the owners desire, but they can be converted into cash at times when the poorer grades cannot be sold. It is often the case that first-rate fruit will sell for a high figure when a medium grade will go far below its actual worth, and no buyers can be found for a poor one. The best peaches are not thrown by the car load into the docks at New York. All the nicest ones which reach New York, or any other city, in good condition, are sold. It is the poor, unripe specimens which are thrown away. The finest grains and nicest fruits, and all other first-rate farm products, can be sold. They will not only sell for higher prices, but also in larger quantities than poorer grades. A family will consume more good butter than it will poor and will be willing to pay a higher price per pound. The same principle applies to all other farm products. Our cities and towns are full of people who must have the products of the farm. Many of these people are poor and must buy the cheapest grade they can find. But there are multitudes who are in good circumstances, and who will not buy a poor grade if they can get a better one. They are not able to pay the extreme fancy price which a few wealthy parties give, but they are both able and willing to pay well for what they buy if it is really nice.

"There has been, is now, and perhaps there always will be, an over-production of poor butter, poor fruit, poor beef, and a low grade of almost everything else which is sold from the farm, but the man who has a nice grade of any standard farm product need not keep it long on hand. Whatever may become of the poorer kinds, his own products will sell. Let the farmer who fears that over-production will be the ruin of the country, take special pains to secure the finest quality in the goods which he takes to the market, and he will soon find that there is a demand for all the products which he can supply."

If quality in every sort of production has so important an effect, it will in dairy production have an enhanced like effect. Bread and beef, however removed from first quality, must be consumed in quantities as necessities: butter will be eaten in quantity only according to its quality as a luxury.

Ensilage.

The new system of preserving fodder green for winter feeding is an important one. It is necessary for the progressive farmer to have every possible help in making an effort to cheapen the cost of production. The experience of pioneers in ensilaging is of value in arriving at the supposed or possible value of the system. As there is more space available in this Appendix, it will be largely devoted to this question.

Location of Silo.

a. "Door opens to feeding-room.

b. "Bottom of silo below basement.

c. "Adjoining barn.

d. "Adjacent to and connected with feeding-rooms.

e. "The silo joins the barn, with a door opening into the feeding-room. About half the depth of the silo is below the floor of the feeding-room.

f. "The top of the silo is even with a plateau, the bank descending ty feet to the stable, and very steep. The ensilage is taken out by a hoisting apparatus over the top of the stone wall and carried in a car on a gently descending grade into a small house, built on the roof of the stable, where the bottom falls out, and the ensilage drops to the floor over the stable.

g. "On level with feeding-room, in rear of stable.

h. "Preferably on sloping ground, so that the discharge door may be on level with feeding-room, and so that a car may used from silo to manger.

i. "On the same level.

x. "A few have been built at a distance from the stables; but generally the silos are located with reference to convenience in feeding, in, under, or adjacent to the feeding-rooms. Local considerations will determine whether the silo should be below the surface, or above, or partly below, and partly above. This is not essential. Where the stables are in the basement of a bank barn, the bottom of the silo may be on the same level, or a few feet below, and the top even with the upper floor. This arrangement combines the greatest facilities for filling, weighing, and feeding."—*National Farmer.*

Construction of Silo.

a. "Rectangular, with six inches of corners cut off from top to bottom.

b. "Oblong or elliptic, but not important.

x. "With rare exceptions, the silos described show a rectangular horizontal section; a few have the 'corner cut off,' and one is octagonal. [The cylindrical form, of which there is no instance in the accompanying statements, seems to have obvious advantages. If under ground, a cylindrical wall is self-supporting against outside pressure, and may be much lighter than would be safe in any other form. If of wood and above ground, the walls may be stayed with iron bands. In any case, for a given capacity, the cylindrical form requires the least possible amount of wall.]

"A given weight of ensilage in a deep silo requires less extraneous pressure, and exposes less surface to air, than it would in a shallow silo. For these reasons depth is important. If too deep there is danger of expressing juice from the ensilage at the bottom.

"Where the ensilage is cut down in a vertical section for feeding, a narrow silo has the advantage of exposing little surface to the air."—*National Farmer.*

Note.—The extracts from the *National Farmer* are answers to questions sent out by the Department at Washington to experimenters or pioneers throughout the country, and the conclusions arrived at by the editor of the journal mentioned. The answers are indicated alphabetically by letters in italics, as *a*, *b*, *c*, etc. The editorial remarks are indicated by the letter *x*. These remarks are commended as worthy of very careful consideration. Let these various ideas and views be regarded rather as suggestive than conclusive. It is almost too soon to present with the stamp of authority what is yet known, or is claimed, about the new system, however promising it is. The writer is sanguine of great things to come of it; but he believes it wise merely to give the reader the means to form his own opinion, that he may act upon his own judgment—intelligently formed.

"The air could be excluded by either Mr. Potter's plan of hermetically sealing the silos, or by pressure. Mr. Mills favoured the latter plan. Mr. Strong also favoured exclusion of air by pressure."—*Ensilage Congress.*

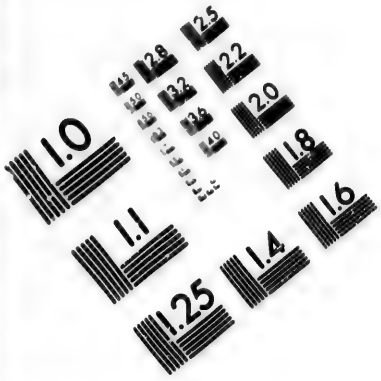
Having never seen a silo, Mr. Pierce adopted the following plan, which proved most satisfactory in preserving the ensilage in first-class condition. His barn is 186 feet long by 46 feet wide, with one end against a slight eminence, and has three floors besides a capacious manure cellar. The foundation wall is built of solid masonry to a height of about fifteen feet, and in one of the corners next to the bank he constructed his silo, which is 32 feet long by 14 feet wide, the foundation wall forming one side and one end to the silo, the other side and end being made of boards nailed to strong posts, with a lining of one tier of brick laid in mortar on the inside. The bottom was then made smooth and the whole surface of the bottom and sides cemented. The silo extends to the second floor of the barn and only a small portion of it is above the surface of the earth around that end of the building. This silo has a capacity of about 250 tons, but this can be greatly increased at very little cost by erecting a double boarded wall twelve or fifteen feet higher, to contain the cut corn stalks when at first put in, but which will in a few days settle down to the top of the cemented wall.

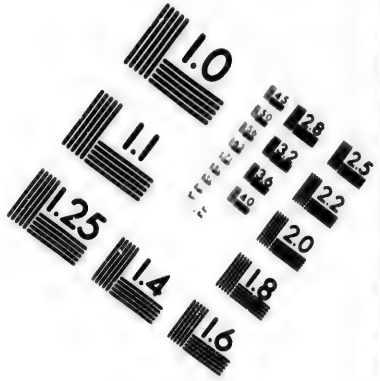
"Before the corn was ready for putting in the silo, Mr. Pierce had prepared another silo opposite the first one, the foundation wall forming two of the walls for the silo, the other walls being of wood, planked up on the inside and double boarded on the outside, with the space between (about eight inches) filled with sawdust. This new silo is divided by a partition wall, thus forming two silos for convenience of filling and feeding from them."—*Montreal Witness, Reporter's Visit to Farm of Mr. Pierce, Stanstead, Que.*

"It may be of some interest for you to know my method of feeding out the ensilage. My cattle stand in two rows facing inward to a drive-way in the centre of the barn; silos back of one of these rows. I suspend a haycarrier so that it can run from the silos to the centre of the driveway. On the hook of the carrier is hung a barrel by an iron bail, which is pivoted just above the centre of the barrel. Through this hole a rope (with a knot in the end to hold it), is run, then a small pulley is suspended from the hook of the carrier, over which this small rope is passed, and then run back into the silo. This contrivance is for emptying the barrel after it has been filled and run out into the drive-way. On the floor of the driveway is a car of sufficient capacity to hold enough for once feeding. This car does not run on a track, but has three iron wheels, the front one easily turning. This whole apparatus for moving the ensilage cost me $32, and with it two men will feed my sixty head in thirty minutes. By using a basket instead of a barrel, one man could remove and dump the food without leaving the silo."—*Dr. J. T. Edwards.*

"In the spring of 1880 I determined to risk an experiment with ensilage, and planted to that end—to wit, peas, corn, and pearl millet. In August of that year I built two silos, each 15 feet long, 12 wide, and 8 deep. This was done by making an excavation in the ground 33 feet long, 8 deep, and 14 wide. Against these walls I built a wall of cement and stone, made into grout, 12 inches thick, with a partition in the centre of same thickness. This left each silo 15 feet long, 12 wide, and 8 deep, which size, according to published capacity, would hold thirty tons each. When building the cement walls I made a door at each end of the silos—the lower door sills two feet from the bottom (which bottom was also made of cement and stones, six inches thick) of silos, three feet wide and five feet high, hung so as to shut fair with the inside facing. This required steps to go down in order to enter. Then the entire doorway was filled with dirt, which supported the door when the ensilage came against it, and it also prevented the air getting into the cracks."—*C. W. Garrett.*

"My silos are each 25 feet long, 15 wide, and 16 deep, with five feet of wood on top of the sixteen feet silos, making twenty-one feet, with pitched roof. We dug the pit from solid clay; stoned up with field stone, two feet thick, to eleven feet; then one foot of mortar wall and four feet of brick wall; then the wood sills bolted to the brick wall (the bottom was well cemented, so it would hold water) sixteen feet deep. The building is clapboarded and painted, with doors at each end, and side door, to fill them both with one opening. The cost was $700; cutter, $85; engine, 8-horse power, second-hand, cost $300; belts, and





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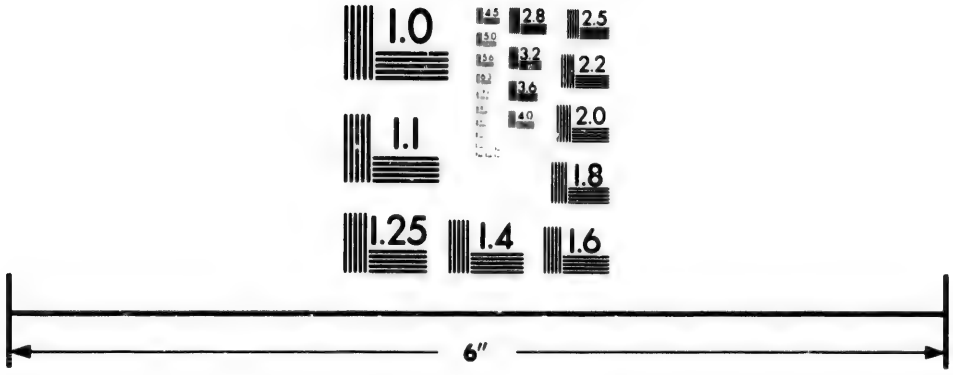

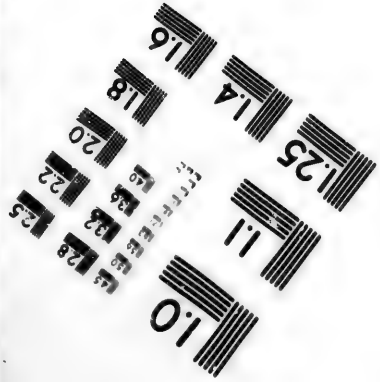

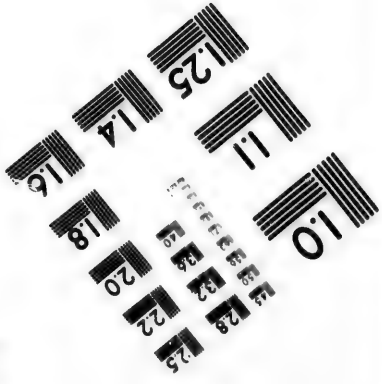

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building to cover engine, $50—in all, $1,135. I could have built a silo in my hard-clay land, without wall, cemented the sides and bottom, then had the wooden building *larger* than the pit, so no rain-water could get in. Anything or place will answer for a pit, where you can keep free from water, while it will be of sufficient strength to bear the pressure—and the more weight the less fermentation."—*H. K., New Hampshire.*

"Now everyone has not a road above his silo, but it is so much easier to hoist it in with a horse and pulley, or other power, than to be pitching it out of a deep hole every time one feeds, that I much prefer it. I take it out on a level with the bottom. At first I throw it over the top until I am down say six feet; then I uncaulk a hole left, as one often is in the bow of a vessel to receive lumber, and I go down again six feet. I mean to move my stalls to the foot of my silo, so that the feed will come down to end of the barn and stable floor. I shall leave enough cut straw to protect somewhat the top of the ensilage as I come down with it. I can push it aside, pitch out and cover when done, and keep all clean and somewhat protected from the air."—*Lewis M. Hatch.*

"In the fall I built a silo 25 feet long, 12 feet wide, and 12 feet deep. This silo was built of cement, common earth and some rocks, the first four or five tiers under ground, and the remainder built up with sharp sand and rocks. After placing the sills, I raised four feet before putting on the roof.

"I found the wall of the first one (built of earth) did not keep its place and needed repairing. It was done with cement and sharp sand. The other two I employed a mason to build, and his work was first-rate. He commenced at the bottom of the silo with cement, good sharp sand and very heavy rocks—so large that it took three men to roll them—filling in with small rocks. In this way it was built up from three to five feet high, and from that to twelve feet with as large rocks as we could handle. These silos were 33 feet long, 14 wide, 12 deep."—*W. A. Foster.*

"In a brief discussion as to the best cement to keep out water from silos, Gen. Hamilton spoke decidedly in favour of Portland cement or its equivalent."—*Ensilage Congress.*

Dimensions of Silo.

a. "13 × 18 feet, by 11 feet deep.

b. "36 × 16 feet; depth, 12 feet.

c. "Two compartments, each 13 × 19 feet, and 19 feet deep.

d. "Four silos, each 29 feet 6 inches by 16 feet 3 inches. One 34 feet by 16 feet 3 inches; depth, 20 feet 5 inches.

e. "40 × 60, by 17 feet deep.

f. "Double: 7 and 8 feet wide respectively, by 24 × 5 feet deep.

g. "Two, each 72 × 16 feet, (depth not stated).

h. "Immaterial, but economy in depth.

i. "14 × 45 feet, by 15 feet deep, divided by a wooden partition.

x. "The silos reported vary in capacity from 364 to 19,200 cubic feet. If entirely full of compressed ensilage, the smallest would hold 9.1 and the largest 480 tons, estimating fifty pounds to the cubic foot. Practically, the capacity of a silo is less to the extent that the ensilage settles under pressure. This should not exceed one-fourth, though in shallow silos, or those filled rapidly and with little treading, it is likely to be much more. A temporory curb is sometimes added to the silo proper, so that the latter may be full when the settling ceases."—*National Farmer.*

"Mr. E. Wright had four silos, each 12 by 40 feet, and 16 feet deep. They held about 200 tons, and he had filled them in two days, using sixteen men and six two-horse teams."—*Ensilage Congress.*

"Col. Wolcott had two pits, each 50 feet long, 15 feet wide, and 21 feet deep, and had not been able to fill them; could not raise corn enough, though he had such 'great expectations' that he engaged a neighbour to store his surplus!"—*Ensilage Congress.*

"So I mean to go for depth, 20 feet at least, attaching importance to pressure; which I will get mainly from the fodder itself."—*Lewis M. Hatch.*

"Chairman Morris said the average shrinkage was one-third the bulk. Ex-Gov Price, of New Jersey, said that agreed with his observation of the silos belonging to Mr.

Havemeyer, of Mountain Side Farm, in which the ensilage crop had shrunk about one-third."—*Ensilage Congress.*

Walls of Silo.

a. "Stone, pointed with cement; shall continue with wood to upper beams of barn.

b. "Stone wall-faced with cement.

c. "Concrete, one part Rosendale cement to four and a-half of sharp, gravelly sand, wet with heavy whitewash, made by slacking quicklime under water two days previous to using. All the field-stone that can be put in are imbedded in the cement in the wall.

d. "Stone wall, with mortar of sand, and water lime, 12 feet 8 inches high, double boards and plank 7 feet and 9 inches higher to roof.

e. "Nine feet of the walls are stone cemented on the inside, and the remaining eight feet concrete and stones. One side is a bank wall, the ground being graded to the top.

f. "Stone. Outside walls dry, 30 inches thick in the bottom, and 20 at the top. Division wall, 20 inches, laid in cement, and all walls plastered by cement. The walls were built by masons, in accordance with their notions of fitness, with the result of an extravagant cost. Above the silo walls in a curb of matched boards, 6 feet high for settling room—of course, a roof covers the whole.

g. "Stone walls, smoothed with cement.

h. "Concrete is better than stone, which is liable to be damp; wooden walls above ground sufficiently strong to bear a pressure, not necessarily air-tight, and do not need to be double, or lined; earth-walls surface-drained, are in some soils as good as is necessary.

i. "Stone, 10 feet; wood, 4 feet.

x. "For walls under ground, stone, brick, and concrete are used. The choice in any case may safely depend on the cost. In firm soils that do not become saturated with water, walls are not essential to the preservation of ensilage. Above ground, two thicknesses of inch boards, with sheeting paper between, (the latter said, by some, to be unnecessary,) seem to be sufficient, if supported against lateral pressure from the ensilage."—*National Farmer.*

Covering of Silo.

a. "Plank, 2 inches thick.

b. "Plank 15 feet long 2 inches thick, crossed with short pieces 4 feet long, so that we can uncover 4 feet at once.

c. "One and a-half inch plank.

d. "Hemlock planks.

e. "Plank, well-fitted.

f. "Immaterial, so that there be a continuous pressure on the whole.

x. "A layer of straw or hay will serve in some measure to exclude air, but is not necessary. Generally boards or planks are placed directly on the ensilage. The cover is sometimes made in sections two feet, or more, wide; oftener each plank is separate. The cover is generally put on transversely, having in view the uncovering of a part of the silo while the weight remains on the rest. Rough boards, with no attempt at matching, have been used successfully. A little space should be allowed between the walls and cover, that there may be no interference as the settling progresses."—*National Farmer.*

"Covering with squares of grooved and tongued boards, a little earth at the edges, etc., will make all air-tight; and for the weight above, and for the top of the fodder, I will get that from several feet of cut straw."—*Lewis M. Hatch.*

Weighting the Silo.

a. "Did not weigh, owing to pressure of business.

b. "900 pounds stone to the square yard.

c. "Field-stone, 120 pounds to the square foot.

d. "Loose stones of a convenient size for handling to the depth of about two feet.

e. "Stones, about one foot in depth.

f. "Stone, fourteen inches thick, and earth banked at ends of plank.

g. "Boulders, 500 pounds per square foot.

h. "Whatever is cheapest; cordwood, sacks of earth or grain, barrels of earth, casks of wood or stone.

x. "Any heavy material may be used. The amount required depends on various conditions. It will be noticed that practices and opinions differ widely. The object is always to make the ensilage compact and thereby leave little room for air, on which depend fermentation and decay. In a deep silo the greater part is sufficiently compressed by a few feet of ensilage at the top, so that there is small percentage of waste, even when no weight is applied above the ensilage. Screws are used by some instead of weights. The objection to them is that they are not self-acting, like gravity."—*National Farmer.*

"Our silo is covered with 2¾-inch plank, and pressed with ten screws, on the principle of jack-screws."—*James Harris.*

"We like *boxes of sand* best for weighting. When you remove them take them to the manure heap, when the land will be worth all it cost."—*H. K.*

"I used stone for weighting, but shall use the self-compressing device which I have, no doubt, will be just the thing for weighting, thus avoiding putting on forty or fifty tons of stone in deep silos, like my wooden one, which is all above ground, and not make such a tremendous pressure on the lower part of ensilage."—*G. Morton.*

"The Congress next discussed various methods of pressing down or weighting the crop after the pit was filled. Mr. Mills used sand and gravel in boxes, as described in his remarks below. Some used boards covered with stones, while others used cloth covered with earth. One used barrels of vinegar; another screws, but his men could not keep them tight as the crop packed so rapidly. What was said showed a great variety of opinions and practices in regard to pressure."—*Ensilage Congress.*

"Secretary Brown read a letter from Senator Warner Miller asking the necessary weight to place upon silos to best preserve the crop. Mr. J. Y. Smith gave it as his experience that ensilage was most perfect when the weight put on was greatest. Chairman Morris said his practice was to weight down the silos with heavy stones placed on planks, afterwards covering the silos with a foot of earth. Col. Wolcott believed a heavy weight was best."—*Ensilage Congress.*

Cost of Building Silo.

a. "About $300.

b. "About $250, exclusive of roof.

c. "$475, including the building above silo.

d. "Between $700 and $800.

e. "About $600.

f. "From 20 cents to $1 per ton of contents. Cheap silos preserved as well as expensive ones; it is only a question of durability.

g. "About $450.

x. "The cost of silos, per ton of capacity, varies from $4 or $5, for walls of heavy masonry and superstructures of elaborate finish, and fifty cents less for the simplest wooden silos. Earth silos, without wall, can be excavated with plough and scraper, when other work is not pressing, at a trifling cost."—*National Farmer.*

"His two silos are in his barn, each 20 feet deep below the surface of the door; they cost him $700."—*Agr. paper on Mr. Mills' method.*

"In April I excavated a large cellar in one of the bays of my barn, using the earth removed to grade up certain places where it was needed. I then built around the cellar a substantial wall of stone and cement, and also cemented the floor. This underground room was 8 feet deep, 14 feet wide, 40 feet long, and this cost me $400. Upon this wall, availing myself of the timbers of the barn, I built a structure of plank and matched hemlock boards, 16 feet high, thus making the whole silo 14 × 20 by 24. Again, using the cross timbers of the bay, I made two board partitions across, thus making the whole room into three silos, each very nearly 13 × 14 feet in size. The total cost was about $550."—*Dr. J. T. Edwards.*

Crops Suitable for Ensilage.

a. "Corn and clover.

b. "Corn.

c. "Corn.

d. "Corn and sorghum.

e. "Corn.

f. "Corn.

g. "Maize and grass for cattle; also rye, oats and peas for horses and sheep, even Canada thistles and salt meadow grass.

h. "Corn.

x. "Corn takes the lead of ensilage crops. Rye is grown by many in connection with corn—the same ground producing a crop of each in a season. Oats, sorghum, Hungarian grass, field peas, clover—in fact almost every crop used for soiling has been stored in silos, and taken out in good condition. There are indications that some materials have their values enhanced by the fermentation of the silo, while in others there is loss. The relative values of ensilage, of the different soiling crops, can only be determined through careful tests, often repeated, by practical men.

"All thoughtful farmers would be glad to get more value from the bulky 'fodder' of their corn crops that is found in any of the common methods. There are accounts of plucking the ears when the kernels were well glazed, and putting the fodder into the silo. The value of such ensilage, and the loss, if any, to the grain are not sufficiently ascertained to warrant positive statements."—*National Farmer.*

"Col. Wolcott had tried ensilage with corn, clover, sorghum, and golden millet, and liked it very much."—*Ensilage Congress.*

"On the 10th of October the silo was opened, and the oats fed to the cows, and found to be a most excellent feed. The cows took on flesh very fast, and kept up their usual flow of milk. The meadow hay came out of the silo in rather a dry state, but was greedily eaten by the cows; yet I am of the opinion that it is worth very little for ensilage, and shall not make use of it another season."—*H. R. Barker.*

"My theory is favourable to Indian corn or sugar cane."—*C. S. Taylor.*

"The prickly comfrey was a failure. It was fortunate that no more was planted. It came out of the silos black and unfit to be used. I have never been able to get cattle to eat it in the green state, and ensilaging certainly does not improve it. The durra produced at the rate of about twelve tons per acre, but it contains too much woody fiber to make an economic cattle feed. The teosinte was also a failure. It requires a milder climate than New York State to mature it.

"Sorghum, I am afraid, will not prove a profitable crop for ensilage in this vicinity. It is very sour when it comes from the silo, which is, I think, due to the excess of sugar which it contains. Cattle seem to eat it well, except the harder portion of the lower part of the stalk, which is so hard they will not eat it freely. Corn, clover, millet, and Hungarian grass make very good ensilage; these with peas and oats, timothy and orchard grass, are the only crops we can put reliance on; but corn I think will always take the lead in this latitude, as it will yield more and cost less per ton than any of the others. We averaged this year about twenty tons per acre, on a farm which has been very much run down, and in a season with a more severe drought than there has been known for years. There were several acres that turned out forty tons per acre, but these were exceptions. The sorghum did not yield on an average over twelve tons per acre."—*Samuel Remington.*

"Col. O. B. Potter thought red clover was, in many respects, the best crop for ensilage, as it settled most compactly, thus meeting the chief demand of the process—to exclude air and retain moisture. When clover was properly ensilaged he found that a piece about six inches cube was a good ration for a cow, being so compact. Had raised sorghum three years, and found it a better crop than corn. It produced more milk and flesh than corn, but exhausted the soil more, and required a longer time to mature."—*Ensilage Congress.*

"Mr. Wright gave his experience in raising rye for ensilage. Had grown nine tons to the acre, but found it inferior to corn. Mr. Reed had raised rye two years and averaged five and three-quarter tons per acre."—*Ensilage Congress.*

Kind of Corn Best for Ensilage.

a. "Prefer Blount's on account of quality.

b. "Blount's Prolific. Further trial necessary.

c. "I think I can raise twice as many tons of Southern White as of Sweet Corn.

d. "I plant the Southern Horse Tooth variety.

e. "Mammoth Sweet Corn.

f. "Southern seed produces much the larger crops, and the more tropical the greater the growth.

x. "The largest is generally preferred; hence seed grown in a warmer climate is in demand."—*National Farmer.*

"Our spring was wet and cold; consequently I did not get all my corn planted until the 6th of June. I used two kinds, the Mammoth Ensilage, and the Southern White or Horse Tooth.

"Where each had the same chance there was but little difference in the growth made." —*Dr. J. T. Edwards.*

"Hon. O. B. Potter had tried all kinds of corn, and was 'prejudiced' in favour of Sweet Corn. Found that the Mammoth Sweet Corn produced the most milk."—*Ensilage Congress.*

Value of Sweet Corn for Ensilage.

a. "I prefer the Sweet, as it is richer food.

b. "Sweet corn, having been cultivated for the grain, is not best for ensilage, as the stalk is not large enough.

x. "It is conceded by many that the fodder of Sweet Corn is worth more, pound for pound, than that of larger kinds, for soiling. Some hold that the same superiority is retained in the ensilage, while others think that the advantage after fermentation is on the other side. The sweet varieties generally do not yield large crops."—*National Farmer.*

"Now, sir, allow me to state that I am of the opinion that Sweet Corn is by far the most nutritious and yields almost as large a crop as the Southern White. My reasons for making this statement are, that my cattle are in much better condition to-day than they were a year ago, and most of them would make good beef. The quantity of grain fed to them at present is less than it was last year, they receiving mostly ensilage and six quarts of shorts per day; and a few of the older cows receive three quarts of corn meal each. The flow of milk from the cows has been much larger, and I believe of better quality than it was a year previous."—*H. R. Barker.*

How to Cultivate Ensilage Crops.

a. "Drills three feet four inches; cultivated but little.

b. "Sow with grain drill, two rows at once, three feet four inches apart. Cultivate to keep ground loose and free from weeds.

c. "Three feet apart, harrowed several times, and cultivated as long as a horse can walk between the rows.

d. "Plant in drills thirty inches apart; harrow when small, and afterwards keep the ground stirred with cultivator.

e. "Sowed in drills—ordinary cultivation.

f. "Corn, in double rows; space two or three feet; space between kernels in rows not yet settled.

g. "Planted in drills, and cultivated three times, the land being well manured.

x. "Thorough preparation before planting is essential. Corn, sorghum, and similar crops should be planted in rows. The quantity of seed corn varies from eight quarts to a bushel and a-half to an acre. A smoothing harrow does the work of cultivating perfectly, and with little expense, while the corn is small."—*National Farmer.*

"I planted twelve acres in four different ways. Two acres were broadcast, two bushels of seed to the acre; one acre in Mammoth Ensilage was planted by hand, one grain in a hill, six inches apart, and the rows three feet apart; five acres were drilled in

by an ordinary grain drill, three to six grains to a foot, rows three feet apart; the other four acres were also drilled in by the same drill, same number of grains to the foot, but double the number of rows, by turning the drill around and driving back, so as to make a row six inches inside the outside row, thus making the distance between the inside rows 2 feet 6 inches. All things considered, I like this last plan the best. The stalks have room to grow, but are not too large. The double rows also make a kind of hedge, which acts as a support. I used in this last seeding about one and a-half bushels to the acre. I do not like the broadcast method at all; the stalks are small; they fall down, and it is very difficult to readily gather them for cutting. I became so disgusted with this that I left one acre uncut, making the product of eleven acres to be put into my silos. Though the season was unfavourable, the growth of corn was beautiful. No fertilizers were used, but the land was part of the rich Conewango bottoms, never cropped but a few times before. The corn stood over twelve feet high, many stalks being fifteen feet high, the blades measuring often seven inches in width, and single stalks weighing from five to seven pounds."—*Dr. J. T. Edwards.*

"Mr. E. Wright had a corn crop, planted thirty-two inches apart, with drills run by horse-power.—*Ensilage Congress.*"

"I used only 250 pounds phosphate in the drill to the acre, where I made a great mistake. This year I shall use 1,000 pounds."—*G. Morton.*

"Mr. C. W. Mills planted his corn in ridges about thirty-two inches apart, putting in forty to fifty kernels, instead of five or six, as usual. The growth was mostly stalks, very sweet, with hardly any ears, making splendid food that could be cut very green."—*Ensilage Congress.*

"Col. J. H. Wolcott planted corn in rows with drills operated by two horses and one man, his machine planting three or four rows at a time."—*Ensilage Congress.*

"As to the best mode of planting I am in doubt. I have planted in hills four feet apart, in rows four feet apart, as thick as a corn drill would sow, and with a wheat drill. A serious objection to the last mode would probably be the liability of the crop to lodge, in an unfavourable season."—*C. S. Taylor.*

"In regard to raising corn fodder, every farmer will have a way of his own; and, although the present feeling is in favour of drilling, with the drills twenty inches apart, experience will vary this according to the quality of the land, the manure used, or circumstances of location."—*Francis Morris.*

"I planted the corn early in May with a corn-planter; rows four feet apart. I plant round and round the piece and end in the middle, so that I have no stopping the feed of the planter in turning the ends of rows; drop about three kernels to a foot, using about three pecks of seed to the acre. Use the smoothing harrow every week or oftener, without regard to rows, until the corn is a foot high; then cultivate if weeds trouble."—*G. Morton.*

"I would suggest that great care should be taken in the planting and cultivation of the corn, in order to secure a large and nutritious crop, and should be cut and put into the silo at just the right time. During the early part of June my corn was planted with an Albany planter in drills five inches apart, the rows being three and one-half feet apart, about three pecks being used to the acre. The land was of the best quality, being heavily manured, about ten cords of good stable manure being used to the acre. The corn grew exceedingly well, the sweet variety reaching a height of between eleven and twelve feet, and the Southern between fourteen and fifteen feet. This was allowed to stand until the ears were fully formed, and cut just before beginning to turn yellow at the bottom."—*H. R. Barker.*

"Mr. Potter, being asked as to the best method of sowing corn for ensilage, said he had tried both ways, and, if sure the wind would not blow it down, should sow it broadcast. Did not think as much could be raised per acre if planted with drills, but found it withstood the wind better."—*Ensilage Congress.*

"Mr. W. M. White said he had planted corn with drills in rows thirty-two inches apart, and got over eleven tons per acre. Had tried sowing broadcast, and only got half as much as by drilling."—*Ensilage Congress.*

Yield of Ensilage Crops.

a. "Twenty to twenty-five tons on land not matured.

b. "Twenty-five tons.

c. "About fifteen tons.

d. "Twenty tons to the acre.

e. "Last year I planted in drills four feet apart, and got about fourteen tons per acre. This year I am planting much thicker. It appears to me that the maximum crop cannot be much greater than thirty tons per acre. Several tons of my last year's crop weighed eight and a-quarter pounds each, and the general growth was quite uniform.

f. "About twenty-five tons.

g. "Eighty-six tons of maise have been raised on an acre; 100 tons may be raised on an acre; average of good seasons, forty tons; average of bad seasons, twenty-six tons.

h. "By actual weight, I harvested on three acres, twenty-three tons to the acre; and on ten other acres about twelve tons to the acre. I think a fair average crop would be fifteen tons to the acre.

x. "Corn produces more fodder per acre than any other crop mentioned. The average for corn is not far from twenty tons—which speaks well for land and culture. The largest yield from a single acre was fifty-eight tons; the average of a large area on the same farm was only twelve and a-half tons."—*National Farmer.*

When to Cut Ensilage.

a. "When the blossoms begin to fall.

b. "When the kernel is in the milk.

c. "When in full blossom.

d. "I cut when the blossom appeared on the tassel. I found in the bottom of both silos a large quantity of the juice, which I was obliged to bail out. On this account I think I shall hereafter let the crop go farther towards maturity.

e. "When the corn is in the silk, before the kernels glaze.

f. "Not, as the French advise, in the flowering, but to have the sweetest and greatest nutriment when the fruit is in the milk; this is a point of great importance; must be careful to anticipate any fading of the leaves.

g. "After the grain has formed on the ear.

x. "The common practice is to put crops into the silo when their full growth has been reached and before ripening begins. Manifestly, one rule will not answer all purposes. The stock to be fed and the object in feeding must be considered in determining when the crop should be cut. On this point must depend much of the value of ensilage."—*National Farmer.*

"My object in calling attention to Mr. Mills' system at the present time is this: He discovered the method himself in 1876, not knowing that any experiments had been made elsewhere (?). His practice and his theory both differ from those of others. First, in respect to maize or any other annual plant, he holds that the plant itself is not ripe or fit to use as food until it has approached its maturity, indicated by the flowering season. He holds that maize should not be fed or ensilaged until the corn is in the silk. The plant is then full of saccharine matter. He holds that the common green fodder known as "cow corn," often sown broadcast and cut in the leaf to eke out insufficient pasture, is unwholesome, that it will produce disease in the animals, and is injurious to the children who drink the milk. The juices of such unripe or immature plants will be found to be bitter, and are, in their effects, similar to the effects of unripe fruits. He proves this case by reference to the examination of the cheese factories in Herkimer county, where the periods in which it has been found difficult or impossible to make good, sound cheese, have been found to correspond substantially with the periods in which unripe corn-fodder was fed in the latter part of the summer."—*Agr. Paper on Mr. Mills' Method.*

"Mr. W. M. White said, the corn sowed latest was most liked by cattle when taken out of the silo. He approved of cutting corn in a pretty green state for ensilage."—*Ensilage Congress.*

"The corn was cut from a field, averaging twenty-three tons per acre, on the 28th and 29th of September—just, by-the-bye, a week too late, for he admitted that it was desirable to cut the fodder just when it was at its best. He now held up a sample of the corn ensilage, and stated that it was too dark, owing to the late cutting."—*Prof. Brown.*

"Mr. Mills said, that when his crops were cut, the corn was perfectly green at the top. He spoke emphatically against feeding any unripe product, and hence opposed raising ears of corn to be cut green. Thought even clover poisonous to cattle if cut before blossoming."—*Ensilage Congress.*

Preparing Fodder for the Silo.

a. "Cut some one-half inch, some three-fourths inch. Used one-horse power.

b. "Cut three-fourths inch. Used steam.

c. "Cut three-eighths inch. Cutter run by a two-horse tread-power.

d. "Cut corn about one-half inch long. Used steam power.

e. "It was cut into pieces about three-eighths of an inch long, using steam power.

f. "The longer bits of stalks are the ones not eaten, if any part is left. Inference—it is best to cut the stalks into short pieces. We cut three-eighths of an inch.

g. "Cut three-fourths of an inch long.

h. "Three-eighths to three-fourths inch is best length to cut, and as keenly as possible, not shredded or mashed as is best for dry stalks. Cutting-machines should not be liable to injury from stones, and the revolving apparatus should not turn towards operator; elevators and carriers may be used to convey cornstalks to silo, and uncut stalks to feed rollers of machine, if it is important to economize labour.

x. "The mowing-machine is sometimes used for cutting corn in the field—oftener the work is done by hand. Various cutters, having carriers attached for elevated silos, are in use, and are generally driven by horse, steam, or water-power. Fine cutting—half inch or less—is in favour. It packs closer, and for this reason is likely to keep better than coarse ensilage. Fodder of any kind may be put in whole, and if as closely compressed as cut fodder, will keep as well, if not better; but it requires much greater pressure."—*National Farmer.*

"I began cutting the 6th of September. Two men did the cutting with ordinary corn knives, two did the loading, and four teams carted to the barn. I used a cutter, and it did its work admirably. I think it would cut sixty tons a day."—*Dr. J. T. Edwards.*

"'Here's a bombshell thrown in our camp!' exclaimed the Secretary, holding out a handful of cornstalks which had been preserved by ensilaging without having been cut into short pieces. Mr. W. R. Strong believed that corn could be preserved without cutting short—that the more it is cut the more it is injured, and that the protection which nature has thrown about the plant is best. Mr. Mills corroborated this to some extent from his own experience, saying there were various methods of preserving crops by ensilage."—*Ensilage Congress.*

"Mr. J. Y. Smith was satisfied it was best to cut the corn before feeding it, thus saving the cattle a deal of work. As the cost of cutting was only twenty-five cents per ton, he thought it should be done."—*Ensilage Congress.*

Filling the Silo.

a. "Carried from cutter into silo with elevator; two men in silo to level and tread.

b. "Took about three days to fill each silo, having men and boys spreading and treading it.

c. "The corn from the field is cut on the upper grade, and descends into the silo till the top is reached, when the curb is filled with the shovel. It is expedient when nearly full, to alternate, so as to give time to settle. A covering of six inches will control the surface wheat. When packing we tread it all we can, but depend more on the natural settling.

d. "Fodder drops directly into silo—spread and tramped by men and horses.

e. "Not important to be in a hurry when filling silo, except to save cost; if trampled every morning it will not heat sufficiently to injure it, even if the process of filling consume a month with intervals of days.

f. "The harvesting, chopping and filling, should be done as rapidly as possible. If convenient the silo should be filled, covered, and weighed in two days.

x. "During the process of filling, the ensilage should be kept level and well trodden. A horse may be used very effectively for the latter. Some attach much importance to rapid filling, while others make it more a matter of convenience. With the packing equally thorough, rapid filling is probably the best.

"It is probable that, with a more general adaptation of ensilage, the best machinery will be provided by men who will make a business of filling silos. This could hardly fail to lessen the costs and bring the benefits of the system within the reach of many who otherwise would not begin."—*National Farmer.*

"I filled in September in the following manner: After having procured a two-horse railway power and a cutter, I commenced to haul in the materials, which, in the first silo, consisted of pea-vines (one-half), green corn (one-fourth) and pearl millet (one-fourth). These I cut in such manner that they would mix thoroughly, not so that they would be in layers. With three two-horse waggons (having to haul the materials a distance of one-fourth of a mile), I filled it in just two days, and closed it up in the following manner (I would here state that during the filling, after the cut material was two feet deep in the silo, one man was kept all the time trampling it down; and when about two feet from the top I put another man, desiring to have it so closely packed that it would settle but little): When full, I laid ordinary inch plank on the ensilage, fitting the edges closely together, and leaving a space of about two inches all around between the plank and walls of the silo, so that they would follow as the ensilage settled. Upon this plank floor, so to speak, dry sand was put to the depth of about five inches, thus surely excluding the air. Upon this was put a layer of pine poles, six to eight inches in diameter, the long way of the silo; then four more layers were laid crosswise, making the thickness of the poles about four feet and the weight about 25,000 pounds. Pine poles are nearly always attainable in the south, and, when taken off the ensilage, are seasoned and make good firewood; so the difficulty, which many appear to have in weighting silos, with us, amounts to absolutely nothing."—*C. W. Garrett.*

"Col. J. W. Wolcott told how the green stuff was loaded on wagon and dropped in barn, ready to be run through the cutter and dropped into the ensilage pit. Employed twenty-five men, and after supper (while filling silo) 'for exercise,' would get as many of them as he could to spend an hour treading down the corn in ensilage pit, so as to get it compact."—*Ensilage Congress.*

"Mr. Potter aimed to filled his silos as quickly as possible, exclude the air, keep the crop at a cool and even temperature, and mix the crops as well as he could. Believed the crops would pack much better when mixed."—*Ensilage Congress.*

"Mr. Mills thinks it very desirable that the stalks be cut with sharp tools while they are perfectly fresh and unnilted, and that the mass shall not be trodden into the pit. He holds that to break the cells in which the juices are contained, any more than is absolutely necessary in cutting, may be extremely injurious and likely to promote fermentation. He therefore fills his silos with the utmost speed, piling on the fresh materials inside of a wooden case of the same size as the pit itself to such a height that, when the mass has settled of its own weight, the surface of the ensilage will be even with the top of the silo. This occurs very quickly under the continuous and even pressure which he places upon it. He manages the pressure by having plank sections each 4 by 13 feet, which are placed upon the surface of the mass and each one loaded with five tons. He says the secret of success is immediate, continuous and even pressure, the use of ripe plants, and the avoidance of any crushing or breaking of the cells."—*Agr. Paper on Mr. Mills' Method.*

"I used an elevator to raise the corn into the silo. The chains that I used were not stout enough; this caused me no little annoyance. My power was one of the ordinary engines used to run threshing machines."—*Dr. J. T. Edwards.*

"Mr. Kennedy said his cutter was run by steam at 1,050 revolutions a minute. He cut corn as fast as two men could spread it in the silo, and kept a horse treading it down. Gathered 1,500 to 1,800 pounds in the field in each load, and could cut such a load and drop it into the silo in four minutes. Had rigging over his silo, so that two men could in one hour get enough for 100 head of cattle."—*Ensilage Congress.*

"Mr. John P. Kennedy packed the corn tight to exclude the air. The secret of the thing was packing. If you have no air you will have no oxygen and fermentation. He locked a horse in one silo and let him walk about three nights."—*Ensilage Congress.*

"Mr. Pierce, about the middle of September, began filling the silo. Two men were employed cutting the corn in the field, three teams were drawing it to the barn, and two men were employed cutting it up three inches in length, with an ensilage cutter driven by horse power; the cutter being placed on a level with the third floor of the barn and directly over the silo. One man was employed levelling the corn as it descended from the cutter, and two horses, each having a boy for a rider, were engaged treading it down." *Montreal Witness.*

"Mr. E. Wright, after the crop was in the pit, had the boys tramp it down; then he put on 100 pounds weight to the square foot."—*Ensilage Congress.*

"I cut the corn one-half inch, and tread well down about corners in filling. In my stone silo I use horses for treading."—*G. Morton.*

Lapse of Time Before Opening.

a. "Two months.
b. "Two months.
c. "Six weeks.
d. "Sixty days.
e. "Thirty-three days.
f. "Two months at least; the longer the better.
g. "Six weeks.
x. "The ensilage should remain under pressure at least until cool, and be uncovered after that when wanted."—*National Farmer.*

Condition of Ensilage when Opened.

a. "Good; to my surprise only three or four inches of top damaged.
b. "Colour changed to brown, but in good condition where properly weighted.
c. "Top one-half to one inch imperfect; below appeared like cooked fodder; smell of New Orleans molasses; seemed perfect.
d. "About four inches of it damaged near the top (but the sheep ate a good part of it), and about four inches next the boards, above the stone work, was not very good, but the rest was highly relished by the stock.
e. "It kept well.
f. "Spoiled two inches deep from top.
g. "Capital order; smelled sweet; cattle ate it ravenously.
h. "Always good when the crop is good, and when it does not get wet in the silo by leakage; the silo improves the quality of the material by increasing its digestibility.
i. "Temperature on opening, about 90°. Condition apparently perfect; fermentation vinous, and apparently stopped at that point.
x. "In nearly all cases the loss by decay was very slight, and confined to the top and sides where there was more or less exposure to air."—*National Farmer.*

"When I took the ensilage out about the first of December I found it was in a perfect state of preservation. Of course it had the alcoholic smell, particularly when you went into it, but after leaving it out in the air it smells sweet and nice like green corn. It is as green as it was when it went in."—*E. D. Tillson.*

"On November 28th, we opened one of the silos and began to feed. About two inches of the corn on top was partially spoiled; the remainder was bright in colour, with a fragrant, vinous odor, and the thick stalks with a decided acid flavour, the leaves less so."—*Dr. J. T. Edwards.*

Deterioration of Quality, if any, after Opening.

a. "Cut down about four feet in width at a time, going from top to bottom, leaving the plank and stones on the rest. No perceptible deterioration.
b. "Very little.

c. "Exposure to air destroys the surface—slowly in cold weather, more rapidly in warm.

d. "No deterioration after opening.

e. "Does not deteriorate if the face is changed every day or two; twenty-four hours' exposure diminishes acidity.

f. "Remained perfect until all had been consumed—about 100 tons.

x. "Generally the ensilage has kept perfectly for several months, showing no deterioration while any remained in the silo, excepting where exposed for a considerable time. It is better to uncover a whole silo, or compartment of a silo, at once, and thus expose a new surface each day, than to cut down in sections"—*National Farmer.*

"I found that when I had stopped feeding for about a week, a kind of mould gathered over it at the edge, but it would not do so for three or four days."—*E. D. Tillson.*

Value of Ensilage for Stock

a. "The steers that I fattened put on flesh rapidly, as the ensilage seemed to prevent them from getting feverish. The thoroughbred stock also liked it well, and their coats handled well.

b. "Equally as good for other stock as for milch cows.

c. "For young cattle, good for growth and thrift; for fattening stock, excellent; for some horses good, and for others not good.

d. "Equally good for horses, colts, sheep, etc.

e. "Oats, peas and rye, or maize, in moderate quantities, for horses; also fattens sheep, and is economical for hogs, steers and bulls.

f. "More than the equal of hay, considering the cost of each.

x. "Ensilage has been fed to all classes of farm stock, including swine and poultry, with results almost uniformly favourable. Exceptions are noted in the statements of Messrs. Coe Bros. and Hon. C. B. Henderson, where it appears that horses were injuriously affected. It should be borne in mind in this connection that ensilage is simply forage preserved in a silo, and may vary as much in quality as hay. The ensilage that is best for a milch cow may be injurious to a horse, and that on which a horse would thrive, might render a poor return in the milk-pail."—*National Farmer.*

"A letter was read from Messrs. Harrington Bros., of Worcester, Mass., who had fed fourteen horses on ensilage food. The horses were used in a livery stable, and had no other feed. Mr. C. W. Mills spoke of the great value he had found in feeding ensilage food to horses."—*Ensilage Congress.*

Value of Ensilage for Milch Cows.

a. "The most economical food we can raise; value, one-third of good hay.

b. "Think it better than any other kind of fodder. Cows prefer it to brewer's grain.

c. "Two tons better than one ton of good hay.

d. "Prefer it to anything I have yet tried.

e. "I think two tons of ensilage equal in value to one ton of stock hay.

f. "Am now, June 30, feeding corn ensilage to four cows, and it is the only fodder fed except grain. Cows that ate nothing but ensilage through April and May are in the finest condition.

g. "Two tons of ensilage equal to a ton of good timothy hay.

h. "Nothing so good as good ensilage.

x. "Ensilage has been fed to milch cows more generally than to any other class of stock, and no unfavourable results are reported. There can be little doubt that its greatest value will always be found in this connection. Several feeders consider it equal in value to one-third of its weight of the best hay, and some rate it higher."—*National Farmer.*

"He might remark that the corn fodder of itself was of very little value as a food for cattle. He called their attention to the fact that green corn fodder as compared with permanent pastures only represented one-fifth. This was not equal to lucerne, although the latter was a comparatively dry grass. Knowing the value of green corn fodder, he

did not attempt to fatten any steers on it; but, as he had said, set aside the cows in order to ascertain its value in supporting cows through the winter, as he considered it might be valuable for this purpose, if not for the former."—*Prof. Brown.*

"We make milk to sell to first-class village customers here, and no fault has been found; but, on the other hand, it is acknowledged to be the best sold in town."—*H. K.*

"His milk has the preference in New York over any ordinary milk, and by analysis proves to be richer than a sample of the best product of Orange county."—*Agr. Paper on Mr. Mills' Method.*

Effect of Ensilage on Dairy Products.

a. "Especially good.

b. "I saw no bad effect on stock or product.

c. "It makes rich milk, more wholesome for children than grass milk.

d. "Could not detect any particular taste, either in milk or butter.

e. "The milk is as good as when the cows are fed on hay.

f. "Not so good as tender grass; better than hay.

g. "It caused an increase of milk from one to three quarts, after three days' feeding.

h. "Improves colour of butter, increases quantity and richness in milk, where ensilage is good.

x. "There is a marked increase in quantity and improvement in quality of milk and butter after changing dry feed to ensilage, corresponding with the effects of a similar change to fresh pasture. A few seeming exceptions are noted, which will probably find explanation in defects easily remedied, rather than in such as are inherent."—*National Farmer.*

"To ascertain the effect of ensilage food upon milch cows, two cows of Mr. Pierce were fed on this alone for ten days, and at the end of that time had increased their daily yield of milk from fourteen to twenty pounds, besides gaining considerably in appearance."—*Montreal Witness.*

"There was exhibited at the meeting perfectly preserved clover, corn, oats, rye and sorghum; also milk and butter produced from this fodder, with testimony upon testimony of its good feeding qualities and perfect digestion, and the good condition of the cattle fed upon it, and of its superiority in every regard over dry fodder."—*Ex-Gov. Price, at Ensilage Congress.*

What Quantity Cattle Consume.

a. "Being short of ensilage, only fed thirty pounds per head per day, with hay and grain.

b. "Sixty pounds per day.

c. "Thirty pounds per head per day.

d. "The milch cows got about fifty pounds per day, the steers forty pounds, and the thoroughbred stock from twenty-five to thirty pounds.

e. "About forty pounds per day.

f. "Corn meal and wheat bran, equal parts by weight, or something equivalent, should supplement the ensilage.

g. "About sixty pounds a day.

h. "Twenty-five to seventy-five pounds per day, or five per cent. of weight of animal; for horses, two and one-half per cent. is sufficient.

i. "An average of eighty-five pounds per head for three-year-old steers, daily, for five and a-half months.

x. "Cows giving milk are commonly fed fifty to sixty pounds, with some dry fodder and grain."—*National Farmer.*

"Mr. Mills fed each of his animals three quarts of grain a day and thirty pounds of ensilage food."—*Ensilage Congress.*

"I think I fed about sixty pounds per day."—*E. D. Tillson.*

"We fed about seventy pounds a day of ensilage to each cow, with nearly a peck of bran and two pounds corn meal. We feed a little hay every three days. We mix the meal with the ensilage."—*James Harris.*

"The large cows will eat about 100 pounds each, smaller ones in proportion, two-year-olds about fifty pounds, and large calves thirty pounds each."—*G. Morton.*

"I there saw 120 head of cattle, mostly cows, and twelve horses, which had been carried through the winter without a particle of hay, no hay being made on the farm. Their food had consisted for over seven months of four quarts of middlings, the rest of ensilaged corn-fodder, gathered from thirteen and one-quarter acres of land. They were being fed on a portion of the last two feet of the last section in the second silo. It was sweet, fresh, and apparently as sound as when first put in. No fermentation appeared to have taken place in this silo."—*Boston Herald, on C. W. Mills' Farm.*

How to feed Ensilage.

a. "Stalks or hay at noon.

b. "For milch cows I should feed fifty pounds ensilage, ten pounds hay; if shorts were not too high, would feed two quarts per day, and if the dairy product was in demand would give a little meal of some kind.

c. "Mix with five or six pounds of mill feed, or three pounds of corn, or cotton-seed meal, with two or three pounds of wheat, shorts or bran.

d. "Fed the milch cows with oat straw, part of the time once, and part of the time twice a day, giving them lots of it, and bedding them with what is left. Mixed bran and cotton-seed meal with the ensilage. The fattening cattle had a little hay, but preferred the ensilage mixed with ground oats, cotton-seed meal and bran.

e. "They had one foddering of hay per day, with brewer's grains.

f. "I prefer to feed dry corn, or barley meal, or linseed meal, with it; it does well without this by feeding hay once a day.

g. "With three pounds of grain daily.

x. "Experiments have been made in feeding ensilage exclusively, and results have varied with the quality of ensilage and the stock fed. It is certain that ensilage of corn cut while in blossom, or earlier, is not alone sufficient for milch cows. It is best to feed hay once a day, and some grain or other rich food, unless the latter is supplied in the ensilage, as it is when corn has reached or passed the roasting-ear stage before cutting. Ensilage, as it is commonly understood, is a substitute for hay and coarse fodder generally, and does not take the place of grain."—*National Farmer.*

"Mr. Pierce has been feeding from one silo since the beginning of last October, at first only one ration each day, but since the cattle have been taken entirely from the pasture, he has fed to them two feeds of ensilage and only one feed of hay each day. Some of the larger cows consume nearly one hundred pounds of ensilage daily, as they get all of it that they will take morning and noon. Although it is from six to eight months since they calved, they are still giving a large flow of milk, from which about one hundred pounds of butter is made weekly, which is shipped to Boston, where it brings about thirty-four cents per pound at present, and, although it is charged four cents per pound of duty, it is more profitable than if sold in Canadian markets. Mr. Pierce has bought a large quantity of cotton-seed meal, and will shortly begin to give a little of it daily to his fattening cattle. He also keeps a large number of horses, which get one ration of ensilage daily."—*Montreal Witness.*

"The cattle did not like it the first day; some of them refused it the second day. They very soon began to eat it with avidity, and since then prefer it to the finest hay. We feed each one forty pounds daily, with one mess of hay, but with no grain whatever."—*Dr. J. T. Edwards.*

"I fed it to my cows. About three-fourths of them took hold and ate it as readily as they would eat hay."—*E. D. Tillson.*

"It was the experience of Mr. E. Wright that it was best to feed ensilage the same day it was taken from the pit. 'It is mine that it is best to feed it the day after,' said Chairman Morris, in which remark several members concurred."—*Ensilage Congress.*

"Ensilage is likely to prove quite as valuable in bridging over a dry time in summer as for winter use. For this purpose it should not consist of corn alone, but of corn and green clover, timothy, millet, peas, or other food richer in flesh-forming matter than corn,

just as would be necessary if the same materials were to be fed to cows without being made into ensilage, and then ensilage should only constitute a part of the food of milch cows, as otherwise it will contain too much acid for a good milk diet."—*Prof Arnold.*

"We make milk to sell to first-class village customers here, and no fault has been found; but, on the other hand, it is acknowledged to be the best sold in town. I very much doubt the propriety of feeding exclusively on any one feed, except June grass, and then a little Indian meal will not hurt the quality of milk. We soil in summer, although all of the younger cows, after being fed green rye, oats or corn all they will eat, are turned to pasture, and fed also at night."—*H. K.*

Condition of Stock when Fed on Ensilage.

a. "Stock did well every way.

b. "Oxen and young stock showed a good gain in growth and health.

c. "Cattle take on flesh rapidly; keep in good condition as to health and flesh.

d. "Most satisfactory in all respects.

e. "My stock look as well, and are in as good health as they have been for twenty years.

f. "My cattle and one horse have sleek coats, look healthy about the eyes, and bear the general appearance of thrift; another horse I never succeeded with.

g. "Perfect health, bright eyes, smooth coats and soft skins.

h. "Good ensilage in proper quantities and varied with dry food at times makes healthy, thrifty animals; it must not be too sour; animals will fatten on it alone that cannot be fattened with hay or dry stalks alone.

i. "Cattle fed as stated previously made a greater gain and were in better health and condition than others fed on twenty pounds of chopped hay and three pounds of grain.

x. "The condition of stock, fed on ensilage, both as to health and gain-weight, has been uniformly favourable."—*National Farmer.*

Cost of Ensilage Feed.

"Mr. E. Wright secured about 350 tons from forty acres (corn)."—*Ensilage Congress.*

"The fodder for my 130 tons ensilage was grown on eight acres."—*G. Morton.*

"The cost of raising, harvesting, and putting away the ensilage last season, estimated at 450 tons, was between $500 and $600."—*Agr. Paper on Mr. Mills' Method.*

"Mr. Mills estimated he had raised 700 tons on twelve acres; had measured neither the product nor the land, yet thought his estimate correct."—*Ensilage Congress.*

"Mr. Mills said the cost of getting into the silo he estimated at seventy cents a ton."—*Ensilage Congress.*

"Last spring Mr. Pierce prepared twenty acres of land for green corn by spreading over it about forty loads of manure to the acre—using one of 'Kemp's Manure Spreaders,' which saves a great deal of labour. Half of this ground was planted with 'Mammoth Ensilage Corn,' and the rest with 'Blunt's Prolific.' The yield of the twenty acres was about 500 tons, which he cut into lengths of about three-fourths of an inch, with a new cutter which is driven by steam power and will cut a ton of cornstalks in four minutes."—*Montreal Witness.*

"The total cost of producing corn ensilage (including cost of seed) put in the silos did not exceed $1 per ton. Another season (with the experience we now have) I think it will not exceed seventy-five cents per ton. The cost of our sorghum crop this season is at least three times as much as the corn, with less than half the product per acre, besides making a poor quality of ensilage."—*Samuel Remington.*

"The cost of raising the corn, harvesting it, and putting it into the silo was $1.44 per ton. I reckoned everything except interest on the land, and manure."—*E. D. Tillson.*

"Col. J. W. Wolcott said he last year raised thirty-four acres of ensilage crops, and produced 460 tons—a fraction over fifteen tons per acre. Had read of forty to seventy tons of corn per acre, but had not been able to get more than fifteen to twenty tons.

Had raised corn fourteen feet high. It made a great difference whether the product was twenty or forty tons to the acre."—*Ensilage Congress.*

"Col. Wolcott submitted a tabular statement showing the cost of his ensilage last year, and the yield per acre of corn, rye, etc., in eight lots, comprising in all thirty-three acres. He calculated that his crop cost $2.55 a ton, including labour, manure, and everything else."—*Ensilage Congress.*

"Discussing the cost of getting crop into silos, Mr. Wright said that would depend much on the distance of the silos from the field. Chairman Morris said he believed the time would come when the pits would be built in the fields."—*Ensilage Congress.*

Value of Ensilage Feed.

"This amount (fodder corn from two acres) fed from ten to twelve head of stock for four months."—*W. A. Foster.*

"Col. J. W. Wolcott had great confidence in the value of ensilage; believed that on one acre of corn a cow could be kept twenty-four months, by getting two crops in a season."—*Ensilage Congress.*

"A letter was read from E. M. Washburne, who had fed milch cows on millet ensilage at a cost of thirteen and a-half cents a day per cow."—*Ensilage Congress.*

"Mr. Pierce is enthusiastic in his advocacy of the use of ensilage as a winter feed for cattle, and he has probably larger practical experience with this sort of food than any other farmer in the Dominion. He maintains that ensilage has a succulent principle akin to grass, and forms the best food which can be got for winter use, as milch cows fed on ensilage give the same results as when fed on a rich pasture, in both the quantity and quality of the milk and butter produced, as well as keeping up the usual growth of flesh, and giving tone and vigour to the system."—*Montreal Witness.*

"The indications, up to this date, show that I shall be able to carry through the winter, in good condition, sixty head of cattle, from the product of eleven acres of corn and twelve acres of grass. Of these sixty head, thirty-five are cows, twenty-three are calves, two are four-year-old working stags. They have been at work every day for two months, skidding logs and drawing out wood from a muck swamp. Their food has consisted entirely of ensilage and hay. They are in fine condition—fit for beef. Of the three hundred loads of sweet, nutritious corn stalks drawn into the barn, I will venture to say that there will not have been wasted two per cent."—*Dr. J. T. Edwards.*

"Mr. Mills kept 120 head of horned cattle from October 15th to May 15th on product of twelve acres, with three quarts of shorts daily to each animal."—*Ensilage Congress.*

Cost of Filling Silos.

a. "About seventy-five cents.

b. "Cost too much, probably $1 per ton. Hope to manage better this year.

c. "$1.25.

d. "Corn, $2 per ton. Draw it one and a-half miles.

e. "Sixty-eight cents a ton.

f. "Thirty-six cents per ton is the lowest cost as yet by hired labour; in this case the silo was convenient to the crop, and the machinery was powerful and efficient—strong engine and large cutter, with high speed.

g. "Assuming $15 per acre for manure, $15 per acre for planting and cultivating, with a crop of fifteen tons to the acre, seventy-five cents per ton for cutting, drawing and packing, ensilage would cost $2.75 per ton.

x. "The cost, from field to silo, is variously reported, from thirty-five cents—and in a single instance ten or twelve cents—for labour alone, to $2 and upwards per ton; though the higher amounts include the entire cost of the crop, not the harvesting alone. There is a general expectation that experience will bring a considerable reduction in the cost of filling."—*National Farmer.*

"On the two days he had named they cut twenty-nine and a-quarter tons of corn fodder, which was put directly through a straw cutter, cutting in about three-quarter

inch lengths. The whole was taken to the silo and well tramped, two men finishing the work in two days, and occupying ten-horse power engine the same time, and the cost was as follows:—Engine and engineer, $5; feeding steam cutter, $2; assistant engineer, $2; two men in silo, $4; train and driver, $6; fiel[illegible]oader, $2. The total cost was $21 for filling the silo with twenty-nine and a-quarter tons, or a cost of seventy-two cents per ton."—*Prof. Brown.*

"We cut into seven-eighths inch pieces 300 loads, which averaged 1,400 pounds to the load, making something over 200 tons of ensilage, or a little less than twenty tons to the acre. We were eight days in completing the work, and the whole cost including seed, ploughing and dragging land, cultivating once, shovel ploughing once, gathering, cutting, and packing away, was $1.62 per ton. Another year I expect to reduce this expense nearly one-third.—*Dr. J. T. Edwards.*

"Mr. W. M. White managed to stow four tons an hour from field to ensilage pit very comfortably."—*Ensilage Congress.*

"Mr. E. Wright found that it cost him thirty to thirty-five cents a ton for cutting and putting crop in silo."—*Ensilage Congress.*

"My whole expense for filling the two silos, outside my own services, horse and boy, was $46, putting in at least 130 or 140 tons."—*G. Morton.*

History of the Ensilage System

"It is now some eight or nine years since the writer of this article first introduced the subject of ensilage of fodder in simple trenches, to the agricultural readers of this paper, as a matter worthy of their careful consideration. Four or five years later, Goffard's improved method, with deep masonry pits and heavily weighted plank followers, was brought prominently before the public, and so bountifully praised by some few who had carried it into practice, as to excite a deep and widespread interest in the subject, such as other more moderate statements naturally failed to arouse. Therefore this system of storing fodder is new with us though old in Europe. It has really been on trial here hardly more than three years, for previous to the winter of 1879–80, the feeding of ensilage had been tested by only a very few farmers, here and there."—*Dr. G. C. Caldwell.*

"The burying of green crops in trenches in the ground has been practised for unknown centuries. The French, in their conquest of Algiers, discovered that it was the usage of that country, and when at a loss for forage hunted out the filled trenches, and made use of their contents for their cavalry. In Asia, on the mountains of Khiva, the adventurous Captain Barnaby found that the only feed for his horse was obtained from the buried crop in the trenches of the country, preserved in the same manner as it was preserved in Algiers. This evidently shows that the practice had an origin far beyond the memory of man, and that M. Goffart was teaching us an art which claims a history long before our time."—*Francis Morris.*

Philosophy of Ensilaging.

"In the first place, the silo must be, as nearly as possible, air-tight. The free oxygen of the atmosphere is the active agent which stimulates the destruction of food elements in the contents of silos, and alcohol and vinegar, and carbonic acid gas, are the chief products of the destructive changes. These come from fermentation, and this cannot go on without air. Hence if a silo is air-tight, fermentation and the changes consequent upon it will be prevented."—*Prof. Arnold.*

"When air touches the fodder, and fermentation sets in, the changes are altogether different. In the first place, one-half of the weight of the gum, starch and sugar is liable to be taken up in the formation of carbonic acid, and carried away in the form of gas, and entirely lost, and what is left of them to be converted into alcohol or vinegar, and not only to become of no use as food, but to work injury to the stock which feed upon it, especially when fed to milch cows. But all these effects can be prevented by excluding

air from the material to be preserved, and the possibility of doing so is what has contributed to the success of modern ensilage."—*Prof. Arnold.*

"The early silos were imperfect and extremely wasteful. They consisted of earth pit-holes dug in the ground in some dry place where water would not penetrate. The material to be preserved was laid upon the bare earth, and then, after being covered with straw, boards, or other material to prevent the dirt from mingling with the fodder, the whole was buried beneath a thick layer of earth. The great defect in such silos was that they did not exclude the air. Though piled several feet thick, earth, either loose or pressed, is not impervious to air. It slowly finds its way through any kind or thickness of earth, and when it reaches the buried ensilage, becomes the support of an active fermentation that destroys a large part of the food elements of whatever the silo contains.

"What occurs in such silos was illustrated by the effects produced in two earth pits made for the preservation of fodder corn at Vienna, under the direction of the experiment station at that place, and, of course, built in the best way. An analysis of the corn before and after ensilage, showed that at fifteen inches from the surface, which would naturally have more contact with the air than the interior, nearly half of the dry solids in the green corn had disappeared—18.85 pounds, the amount of dry matter in 100 pounds of green corn, was reduced to 9.93 pounds. Three feet below the surface, where less air penetrated, the loss was less—18.85 were reduced to 12.47. The loss was chiefly in the starch and sugar, which had more than half of them been converted into carbonic acid, and passed away in the form of gas, while another portion of them were lost by being converted into alcohol and vinegar. Other soluble and valuable constituents of the corn were absorbed away by the earth. The woody fibre was but little affected, and this caused it to maintain nearly its original bulk, and to look very much as it did when first buried, and gave it the deceptive appearance of being as good as before burying, though it had lost more than half of its food value. Since, in such silos which are supposed to be better made than the average, there is a sufficient influx of air to keep up a fermentation sufficiently active to destroy, in five or six months, half of the food elements in the materials preserved; the average earth pits must have been too destructive to effect any economy in preserving anything except such as could be preserved in no other way, such as the tops and pulps of beets from which sugar has been made, frost bitten potatoes or frosted herbage, and fodder corn, when the weather is too wet to dry it. In such cases it might be better to save part than to lose the whole.

"In a well-built, air-tight, modern silo, this great loss is nearly all obviated. The changes will go but very little beyond the formation of lactic acid, and the consequent loss need not exceed ten per cent. of what it would be if the same fodder had been preserved by drying in the open air. There will always be some loss. It is impossible to get fodder into a silo and covered, without having some air mingled with it; but if the covering is air-tight and well pressed down, the little free oxygen contained in the interstices in the fodder will be all used up in two days' time, and the little cavities be all filled with carbonic acid and other gases harmless to the ensilage. Fodder preserved in such structures will keep almost indefinitely, and make good milk if it was good milk-producing food when it was put in. No one need expect to take out any more food than he puts into a silo, nor need he expect it to be any better than he puts in, for, though in some respects it may be a little better, on the whole it may reasonably be expected to be a little depreciated. But any such loss or depreciation is much more than over-balanced by the consideration of having green and succulent food in winter's cold and summer's drought, for promoting a full and continuous milk yield, and from the greater facility, cheapness, and certainty in its preservation than would otherwise be obtained."—*Prof. Arnold.*

Quality of Ensilage as Feed.

"Making a silo air-tight does not prevent all change in its contents. With plenty of moisture and a medium temperature, the starch in the vegetation will by degrees be changed into sugar, and the sugar into lactic acid. These changes do not require air, and will, therefore, take place in any kind of a silo, unless counteracted by dessication or an extremely low temperature. But these are not destructive changes. They consist in

little else than a rearrangement of the atoms of the starch and sugar, which does not materially affect their being utilized for food, so that while unavoidable they are comparatively harmless. Unless fed in excessive quantity, the food in which these changes have occurred remains good for producing milk if it was good before, for the changes are identical with those which take place in the same substances in the bodies of animals preparatory to their entering in the blood, into which they cannot go in the form either of starch or sugar."—*Prof. Arnold.*

"The primary idea of ensilage was, he contended, to be able to preserve the fodder, and keep it as fresh and nice as in the summer time. This did not include any idea of enhancing the value of the fodder, for, as he understood the system, its object was not to increase the value but to preserve the freshness of green fodder. His idea with corn fodder, however, was that sixty per cent. of its value was lost in shucking it in the fields. The damage did not come from frost so much as the alternation of freezing and thawing." —*Prof. Brown.*

"I have satisfied myself that stock can be kept fat in the winter on ensilage alone." —*G. Morton.*

"Organic chemistry is almost in its infancy, and some go so far as to say that it is not yet born; for when analytical chemistry takes hold of an organism it must first destroy it before it can tell us of its composition. That which is thus destroyed cannot be recreated. No one can tell how it is that plumbago, charcoal and the diamond can all be carbon, one three and three one; or how is it that the white of an egg and the venom of a rattlesnake are composed of the same elements and in the same proportion. The best chemists in the world confess their ignorance of illotropism and isomerism. We need not, therefore, be surprised if science has not yet explained some of the most interesting facts in connection with ensilage. For example, ensilage or preserved food, is more digestible, and therefore more nourishing than when first cut. This is a point of great importance. It is as true of the beast as of the man, that what he digests and not what he eats, most promotes his welfare. Consequently, if we increase the digestibility of an article we have increased its food value. This is what we do in cooking dough and potatoes. We do not materially change their composition, but no person will hesitate to prefer for his dinner the cooked food. When the green fodder is first placed in the silo, a slight fermentation takes place which develops heat. Now we do not know precisely what change is thereby affected; perhaps something like this occurs: Fifty-six per cent. of corn stalks are starch and woody fibre; eleven per cent. is sugar. Perhaps the oxygen not yet excluded from the fodder, unites with the sugar, producing an acid which acts on the starch and fibre, thereby converting them into cellulose or grape sugar, a process somewhat akin to our bread-making.

"Whether this be true or not, the fact remains that it is more digestible and better agrees with stock than the fresh cut corn-stalks. Have not all of us observed something similar to this change? Last year I saw cattle, although in fine green pastures, eagerly eating Canada thistles which had been cut and thrown into a heap the day before. Many farmers have noticed that stock are more fond of corn-stalks the day after being cut, and prefer various kinds of wilted fodder to the fresh. The chemical difference between the green and the ripe apples is very slight, yet the child dies from eating the one and thrives on the other.

"Here is a Bartlett or Duchess pear, hard and just gathered; eat one, and you suffer for hours from indigestion, if you are not made sick. Lay them aside for a time, and although nothing has been added to or taken from them, yet by some change in their molecular or chemical structure, they have now become palatable and nutritious. I do not claim that we can scientifically explain fully why this is so, but think that we are prepared now to accept it as a fact."—*Dr. J. T. Edwards.*

"First, then, as to palatableness, and as to wholesomeness when used in a reasonable manner, good ensilage is not exceeded by any other coarse fodder; these qualities are so well established as to need no discussion. Second, a superior article of fodder must be reasonably nutritious and productive; it should be a complete fodder with about the right proportions of the several nutrients for the best utilization of all of them for profit. Judged by the German feeding standards, the dry substance of fodder corn, which consti-

tutes the bulk of the material for ensilage, does not meet this requirement; like ordinary hay of timothy, redtop and blue-grass, it is much too poor in albuminoids. Although these feeding standards have, of late, been somewhat severely criticised, still there is not yet sufficient ground for setting them aside altogether, and they are in the main in accordance with experience. Judged by effects, also, ensilage of maize and ordinary hay are about equal, if the same weights of dry substance are compared. In numerous cases this ensilage appears to have taken the place of hay in the rations of cows in milk, and of growing and fattening animals without detriment to production. Especially noticeable is the testimony as to its favourable effect on the yield and quality of milk and the quality of the butter. It is not uncommonly thought that it is even equivalent to the best hay of the farm, but the opinion lacks a sound foundation on the results of careful comparative experiments with the two kinds of fodder, as well as theoretical support."—*Dr. G. C. Caldwell.*

"Mr. C. W. Mills, the originator of this special method, does not accept the theory which assumes that there is a generation of carbonic acid gas in the material. He disproves this theory by the allegation that his silos are twenty feet deep, forty feet long, and thirteen feet wide, two in number. He feeds from sections of four by thirteen feet, in all, ten sections, each one removed vertically. Occasionally the chickens fly down to the bottom of a section, where, if carbonic gas were generated, they would die, but they seem to enjoy themselves in the abundant food that they there find."—*Boston Herald, on C. W. Mills' Farm.*

"We opened our silo on the 10th of November, and there has been nothing taken out of the mangers until the other day, and it was a very little."—*James Harris.*

"I opened the silo first filled the 7th of November, and found the contents in a state of perfect preservation. It had undergone a vinous fermentation, but was entirely sound. My stock accepted it at once. Not only my cows are fed upon it, but my work-horses and mules, and, almost constantly at work, they are in as fine condition as I could wish—though I have given them only two-thirds rations of corn, or two-thirds of what would have been given them had I been feeding them on hay or corn fodder. I have particularly noticed my driving horses; they stand long drives without any appearance of failure or looseness of the bowels. I therefore conclude that, as a food for work animals, it is at least equal to hay or fodder. This I consider of great importance to us of the south, as we have great difficulty in the cotton producing section in obtaining a sufficient supply of long forage for our work animals.

"The contents of the first silo, one-half pea-vines and one-fourth each corn and pearl millet, were found to be excellent. I am now feeding the other, which contains two-thirds pea-vines and one-sixth each corn and millet, and find this even better than the first; the stock like it better, and will push aside the corn and millet until every particle of the pea-vines is eaten up. I am satisfied that one-fourth more pea-vines can be put into a silo than corn or millet, as they become very compact, so there is less danger of damage in the silo."—*C. W. Garrett.*

"December 20th, I opened one of the silos which contained corn, durra and prickley comfrey. There was about two inches slightly damaged on the top, but our pigs ate this readily. Some of the cattle at first did not take to it, but very soon did, leaving hay, meal and other feed which they had been accustomed to for the ensilage. The ration I am now feeding, consists of about sixty-five pounds of ensilage, four pounds of bran, and two pounds (of the new process) linseed meal. When taken out of the silo it has a slight vinous odor, but after been exposed for a short time it has rather a pleasant smell."—*Samuel Remington.*

"Attention was attracted to the sour and fermented smell and taste of most specimens of ensilage shown, which elicited comment, especially that none of the experimenters represented had produced what M. Goffart says ensilage food should be—*i. e.*, without perceptible odor and of insipid taste. The samples of butter and milk, however, were pronounced superior. A number of the ensilage exhibits were from quite a distance, as Wisconsin and Nebraska, while the Middle and New England States were well represented."—*Ensilage Congress.*

"Mr. Wright had never seen any ensilage food like that described by M. Goffart

which was said to be perfectly insipid, without perceptible odor. Referred to samples present as evidence that no such product had yet been secured in this country."—*Ensilage Congress.*

Effect on Fodder of Ensilaging.

"A scientific agriculturist and several chemists who have analyzed samples of ensilage contend that there is a serious loss sustained by reason of fermentation. They even contend that the loss of valuable elements is greater when forage is preserved by ensilage than when cured by drying. It should be borne in mind that the scientists who advance this idea have had no practical experience with which to test the correctness of their proposition. They are not content with saying that there is a loss in the amounts of the various nutritive elements from a chemical standpoint. We might perhaps admit, that a stalk of corn does lose some of its *intrinsic* value, but they assert that its *feeding* value is diminished. Now, without questioning their great ability and their general accuracy, I must contend that the facts do not warrant practical men in accepting their conclusions."

"Why is it that the scientists and the practical men so utterly fail to agree? Let us examine this thing carefully. The scientists may not be entirely wrong, although, I must say, they were never farther from right than they are upon this subject. In the first place, I contend that the chemical analysis of green forage and of ensilage cannot be depended upon to determine their feeding value, for no account is taken of the loss in drying, which is the first step in analyzation. Green grass and other forage plants contain over eighty per cent. of water. In the process of curing by drying, about seventy per cent. of water is evaporated. This seventy per cent. of water, whether it is dried out of the plant in the field or evaporated in the laboratory, carries with it a large amount of valuable nutrition. That which passes of is just what makes the difference between June and winter butter—about ten or fifteen cents a pounds. If it does not lose by drying the first time, why is it that it loses so much by drying the second and third time after being wet? The *wetting* does not injure the forage, else cut-feed would be injured by being sprinkled, and steaming fodder would utterly ruin it. It is the drying *after* the wetting that robs the forage of its value. Living plants take up the elements of growth in liquid form; each acre of grass or grain absorbs from the earth many tons of water during its growth. The living plant has the power of distilling this water, appropriating those elements which are essential to its growth, and of exhaling the pure water. Those elements which are not required by it are supposed to be returned to the soil. This power exists only while life remains. We walk across a field of luxuriant grass after a grateful shower. Evaporation from the countless millions of pores is going on almost as rapidly as it is from the field of new-mown hay. In the previous case we perceive it not, but in the latter the sense are almost overpowered by the density with which the air is laden with the most valuable elements of nutrition. Whether the drying is done by the chemist in his laboratory, or in the field, the water which is dried out of the plant leaves it in the form of *hay tea.* It is obvious that the first drawing of that tea must be the strongest. When chemists profess to give us an analysis of ensilage or of green forage, they are not giving us an analysis of ensilage or of green forage at all. What are they giving us? Why, an analysis of plants dried in one way to compare with plants *dried* in some other way. As well take both samples from the same hay-mow."—*Dr. J. M. Bailey.*

"Important changes take place in the silo. Starch, one of the principal constituents of corn, is undoubtedly converted, by the action of milk vegetable acids, into glucose. A portion of the cellulose, a woody fiber, is indigestible. When converted into sugar or glucose digestion is made easy. We can test very nearly the increased amount of food which a horse requires when hard at work over that which is ample when he is idle. The difference is the amount used up in sustaining the muscular system under severe toil. When gently exercised a horse is kept in good condition upon fifteen pounds of hay, or thirty pounds of ensilage, and two or three quarts of oats per day. When put at severe work the grain ration must be increased to eight, ten or twelve quarts. The increased ration measures the cost of working the muscular system. This is one of the things we know. Now comes of the things we do not know, and it is this: How much more foo

is consumed in sustaining the digestive organs when they are worked hard than when they are given but an easy task to perform? It needs no proof to convince you that green food or ensilage is vastly easier to digest than hard, dry forage. There is, undoubtedly, as much difference in digesting ensilage and corn fodder, as it is usually cured, as there is between fresh apples or canned peaches, and dried apples or dried peaches."—*Dr. J. M. Bailey.*

"Mr. J. Y. Smith had seen brewers' grains opened in London which had been closed for nine years, and the grains were as good as when first deposited."—*Ensilage Congress.*

"I think crops could be kept in pits or silos ten years and be as good as when cut."—*Hon. O. B. Potter.*

Relative Cost of Ensilage.

"Third, an important quality of a superior fodder is ease and cheapness of production; for however palatable, wholesome, nutritious and productive it may be, if much care, hard labour and expense are required to get it raised and safely stored, it may be practically inferior to another kind of fodder of lower quality that is more easily produced. Fodder maize is commonly spoken of as a highly productive crop; perhaps it gets more credit in this respect than it deserves. Leaving out all claims of yields of forty to sixty tons or more to the acre, we will take twenty tons, as an average crop in fair season and with fair culture; this would contain about 5,200 pounds of dry substance. Almost as extraordinary crops of fodder roots are claimed as of fodder corn; but under like favourable conditions as assumed above. 750 bushels of mangolds may be safely counted upon, weighing, at sixty pounds to the bushel, 22.5 tons, and containing 5,400 pounds of dry substance. An average crop of hay, say 3,500 pounds, would contain about 3,000 pounds of dry substance. Now as to the cost of the yield of an acre in the three cases: Judging from the few reports, that have been made public, of a careful account with the ensilaged maize crop, it may be safely allowed that entire cost of every ton of fodder deposited in silo soil need not exceed $2.50, or $19.23 for every ton of dry substance. The cost of a bushel of mangold is given at from five to eight cents; at 6.5 cents a bushel the cost of the 5,400 pounds of dry substance per acre would be $52, or of a ton $19.26. It is commonly acknowledged that roots are costly; a recent English writer says it is the most costly crop raised there. Then corn fodder put into the silo is a costly crop also. If the special friends of the system say that its cost has been set too high, the friends of the root crop may say that 900 or 1,000 bushels can be produced on an acre at a cost of 5.5 cents instead of 6.5 cents a bushel. If we put the average cost of the acre's yield of hay stored in the barn at $10, then for the cost of a ton of dry substance in this standard article of fodder we have $11.66. In these estimates no account is taken of the loss suffered by the fodder through fermentation in the silo because we have as yet no accurate data by which to calculate that loss in the case of heavily weighted ensilage in tight masonry pits. That it can be left out of account without leading us far astray is indicated by results given by Professor Cook, of New Jersey, who found that the loss of dry substance in the curing of the fodder in the old way was almost as great as by fermentation in the silo.

"In respect of cheapness of production of a given quantity of nutrient substance, corn-fodder, whether put into the silo or not, has therefore no advantage over roots, and is inferior to even ordinary hay. Here we find the weak spot in the system, and it is a weakness that should lead one to think of the cost before investing too largely in expensive masonry silos, and to watch with the greater interest the results obtained in simple old-fashioned trenches, such as some are using even on a large scale in this country. To this view of the matter, it will be objected, that ensilage corn fodder has a feeding value that is not indicated by its composition, and that a pound of its dry substance will produce more milk than a pound of dry substance of similar composition as to albuminoids, fat and carbhydrates in hay or other fodder. To this it must be replied that as yet no satisfactory proof has been given that by ensilaging corn-fodder it is made any more nutritious, digestible or productive. For this proof we must wait until careful digestion and feeding experiments shall have been performed with corn-fodder from the same field, a part ensilaged and a part cured dry."—*Dr. J. C. Caldwell.*

"Crop averaged about twenty tons per acre. This land (from which I got 130 or 140 tons ensilage) would not have produced five tons of hay."—*G. Morton.*

"Do the golden lands of California bear any comparison with the fortune that is at the feet of every farmer on the Atlantic border? One man can cultivate, with ease, fifty acres of corn fodder, and after it is ready to cut (which is when it is in tassel) it would be easier to put away 1,000 tons of it than 100 tons of hay. A first-class feed cutter will dispose of 100 tons of fodder a day. Whether you have rain, wind, or a hot sun, you can work all days alike—the feed is equally good. In my experience I could never detect any difference in its quality."—*Francis Morris.*

"Now, on the basis of three tons of ensilage equal to one ton of hay, if one ton cost $2.50, then my hay would cost me $7.50 per ton. Calling my 200 tons of ensilage sixty-six tons of hay, costing only $7.50, when hay is worth $20 to $25, the saving for one year would be (calling hay only $20) $12.50 per ton, or $825 for the year. The silo pays me, and I have not the least disposition to quarrel with my neighbours if they decline to adopt it."—*H. K.*

Comparative Value of Ensilage.

"A member who had carefully calculated the matter, remarked that he found one ton of ensilage grass to equal 1,000 pounds (half a ton) of hay."—*Ensilage Congress.*

"Prof. Brown had concluded if good hay was worth $10 per ton, this corn ensilage would be worth $5.—*Brockville Convention, 1883.*

"The value of this ensilage food is equal to timothy hay as one is to two. One ton of timothy hay is equal to two tons of corn fodder. If a ton of hay is worth $20, a ton of corn fodder or ensilage is worth $10."—*Francis Morris.*

"I consider that two tons of ensilage is as good as one ton of hay."—*E. D. Tillson.*

"Mr. Mills said he would rather have one ton of his ensilage crop than a ton of the best hay."—*Ensilage Congress.*

"I am confirmed in the belief that three tons of the ensilage is equal in feeding value to one ton of hay. The yield of ensilage corn was eighteen tons per acre, equivalent in a feeding value, in a combined ration, to six or ten tons of hay per acre. Admit, only, that three pounds of ensilage will take the place of one pound of hay, in a mixed cattle ration, even then if animals fed with it thrive, are healthy, and present a general appearance much like that resulting from grass feeding, coming out after four or five months' confinement, with sleek coats, with not much, if any, loss of weight, and with no more shrinkage of milk yield than we ought reasonably to expect as the time from calving increases, we must conclude that there is some virtue in fodder prepared in this manner. Claim only this, and is it not a profitable and a practical method of securing large yields of corn, sorghum, and other forage crops, and preparing them for convenient and economical feeding?"—*Prof. Samuel Johnson.*

"Experiment.—I fed ninety three-year-old steers, divided in three lots; cattle and feed weighed monthly:

"First lot.—Feed twenty pounds hay with three pounds grain daily; run in yard with shelter.

"Second lot.—Kept in warm stable and stanchions; fed seventeen and a-half pounds hay, one peck mangolds, and three pounds grain.

"Third lot.—Fed eighty-five pounds ensilage with three pounds grain; this lot gained one-quarter pound a day more than No. 2, and one-half pound more than No. 1. This cost was five per cent. in favour of ensilage."—*J. B. Brown, in National Farmer.*

"I am more than ever convinced that the idea I suggested two years ago, that ensilage will prove a cheap substitute for roots, will be approved by any farmer who will make the trial. Farmers who have had experience in feeding stock know how desirable it is to have some succulent food as a part ration at least, during our long, cold winters. Roots are a desirable cattle food, but an expensive crop for the average farmer to raise and handle. But few farmers have the facilities for storing them in any quantity. They must be buried in the field; and in the winter, with the thermometer below zero, digging out the roots and getting them to the stock is not a desirable task. If ensilage will give us the succulent food at less cost, in shape to be easily handled and occupying but a small

space in storage, it must prove of value. What are the farmers in Michigan to do with the coarse fodder raised on our farms, but to feed them? They are too bulky to transport to market—they must help to make beef and mutton; but the farmer needs something to feed in connection with them to make them of more value, and the ensilage will help out in this direction."—*Prof. Samuel Johnson.*

"I believe that an acre of land can be made to support ten cows the year round. Two crops of maize and a crop of rye, on an acre made as rich as a garden, will certainly produce 100 tons of green food, and this would certainly feed ten Jersey cows. Whether the land could repeat this is a question which only the experiment would decide."—*Francis Morris.*

"One of the great advantages of ensilage is that you have a rich, moist food to feed with other kinds, and, by judiciously arranging it, keep your stock in just the right condition, bringing it nearer summer feed. It is cooling, and, from feeding it, you run much less risk of injury from over-feeding of grain. Grain is usually cheaper than hay, but if you feed too liberally of it you give the cows the garget. That has given us formerly much trouble; very seldom now, however. If we feed all ensilage the stock are too loose in their condition—just the opposite from feeding all hay and dry feed. The silo comes in best where you are limited in the amount of land, and you must get the most from a few acres, like farming in a village. I have some fifty acres of tillage land and twenty-five acres of pasturing. Part of my land is two miles out; the balance of the tillage is in the village, and worth, perhaps, for house lots, $300 per acre. I must get two crops—one of winter rye and one of corn. To do it my corn cannot be cut much before the frost comes, when it is too late to cut and dry in the field. Corn, where you have twenty-five tons per acre (if you could), will cost near or quite as much as to cut and pack in silo; but the fact is you cannot dry the corn so late in the season as the average of weather we have late in the fall. To the farmer, where hay is cheap, say $10 to $12, it is a different thing; but there it would pay to sell some hay, and feed some ensilage to keep the stock in better condition. Would rather raise ensilage than roots; it seems to take the place of roots."—*H. K.*

"Mr. A. A. Reed had for three years ensilaged corn, clover, grass, sorghum and rye, of each of which he presented samples. Had satisfied himself of the great value of ensilage by weighing his cows, and their food and products, with and without ensilage, and gave statistics showing that the same cows, with ensilage food, would thrive and give more and better milk. His cows drank less—sometimes not at all—when fed on ensilage; the food was so moist with the natural juices that often the cows did not need water."—*Ensilage Congress.*

"Mr. O. B. Potter had made an experiment with fifty-six cows, which, when fed ensilage, thrived and gave more and better milk than when in good pasture. When they were fed on ensilage and two quarts of barley meal he sent fifteen cans of milk (forty quarts each) to New York daily; but when turned on pasture he could send only eleven cans. When cows are turned out in cold, damp weather they lose twenty-five to thirty per cent. daily; hence he kept his cows in and fed ensilage and meal."—*Ensilage Congress.*

Relative Advantages of the System.

"It is now pretty well established that there is some advantage to be gained from the preservation of green food in silos; and also that the extent and certainty of that advantage depend chiefly on the conditions comprised in the silo, in which the preservation is effected."—*Prof. Arnold.*

"While travelling through Great Britain last summer, I was surprised to see how large a portion of the arable land there is employed in the growth of turnips and also the almost uniformly splendid appearance of this crop, more especially in Scotland. The North British farmer seems to consider this crop as the sheet anchor upon which alone he may rely with any confidence of success in his struggle to hold the British cattle market against foreign competition. Well may the Scotch farmer look with pride on his turnip fields and then on his fat stock, the latter the outcome of the former, and thank Providence that he is still able to hold his own, against all foreign competition, in supplying John Bull with

the choice cuts of beef which are so tempting to his palate. I have seen in Scotland prize cattle that would do credit to any show ring, and which, since they were calves, had only received, in addition to their pasture feed, a bountiful supply of straw and turnips. I felt sad upon reflection that in most places in Canada turnips cannot be grown profitably, while a large portion of the straw is almost wasted so far as the feeding of good stock is concerned. Fortunately the Canadian stock feeder is likely to realize in ensilage more than a substitute for turnips, in supplying an abundance of cheap and health-giving winter feed for his cattle."—*Rusticus, in Montreal Witness.*

"Mr. Pierce keeps about one hundred head of horned cattle on his farm at present, and, like many other Canadian farmers, found great difficulty in growing sufficient roots to feed with the dry fodder in winter."—*Montreal Witness.*

"What then are the well-established advantages of ensilaging fodder? The system applied to fodder corn enables the farmer to produce from a limited area of ground a larger quantity of nutrients for cattle than can be obtained in any other crop except roots, and at no greater cost than in roots. The fodder thus obtained is, without any further preparation, most palatable to cattle, is eaten without waste, and is perfectly wholesome. Like the root crop it carries into the winter's feed some of the succulency of the summer pasturage, and, given with the dry feed, keeps the animals in a better condition, and therefore may enable them to produce more milk or flesh on the sum total of the fodder of all kinds coming from the farm. Over roots it possesses the advantage that, being somewhat richer in albuminoids, it requires a smaller addition of other fodder still richer in this nutriment to make a suitable ration for the production of milk, or for the fattening of growing animals. In the degree of independence of the state of the weather at the time of harvesting it possesses an advantage over any other summer crop, since it may be stored in any sort of weather in which work is possible out of doors. In some season this may be a very importantant matter, and it incurs no risk from the frosts that occasionally damage the root crop. Finally, by storing early green crops in this way a provision, often sadly needed, may be made for maintaining the supply of succulent fodder in the late summer and early fall, when the fields are so often burned up by drought, and both pastures and stock will suffer by continued forced pasturage, and the necessity of resorting to dry feed will cause diminished production, at a time when the whole machinery of the farm or dairy, or both, may demand that production still be kept up at least to the average mark. Further experience and experimentation with ensilage may show that the system is capable of accomplishing more than has been granted. Until this has been conclusively shown the prudent farmers will not calculate upon more."—*Dr. G. C. Caldwell.*

"I believe the best part of the crop would be lost by curing and drying."—*Hon. O. B. Potter.*

"Mr. Potter said that *cured* clover required twice as much handling as green clover as used for ensilage. Another advantage was that a green crop could be gathered in the rain and put into the ensilage pit wet without injury."—*Ensilage Congress.*

"It will be acknowledged, also, that summer pastures are better for stock in every respect than winter hay;—that if we could in some way preserve for the winter those qualities in the feed of cattle which round their muscles, overflow the milk pails, and make fragrant and sweet their butter, we should produce a result in which all would rejoice."—*Dr. J. T. Edwards.*

"Any necessary loss or depreciation is much more than over-balanced by the consideration of having green and succulent food in winter's cold and summer's drought, for promoting a full and continuous milk yield, and the greater facility, cheapness, and certainty in its preservation than would otherwise be obtained."—*Prof. Arnold.*

"Prof. S. Johnson, of the Michigan Agricultural College, states, after his second year's use of ensilage, that 'he is confirmed in the belief that three tons of ensilage are equal in feeding value to one ton of hay,' as the yield of the corn grown was eighteen tons per acre, that is equivalent to six tons of hay. But it is as easy to grow two crops as one on the same ground, viz.: one crop of winter rye and one of corn, and as these two combined will make at least twenty-four tons of ensilage, the yield is raised to an equivalent of eight tons of hay per acre. As twelve tons of ensilage will feed liberally

one cow or steer it is practicable, by this system, to keep two cows, or feed two steers, for each acre. Does not this practice then promise to solve the problem of 'how to make the farm pay,' especially in localities where land is dear, or where it is poor and can only be enriched by feeding stock upon it."—*Agricultural Paper.*

"One good point made by Mr. Potter was that, there being no danger of fire in silos, insurance became unnecessary."—*Ensilage Congress.*

"If we should give up the silo we should stop making milk for the market. With milk at six cents per quart in the winter and five in the summer; with hay at the present price, Indian meal at $1.50 per bag, shorts $23 per ton, and cotton-seed meal $32.50, it would not pay us for the trouble where we hire all the work done. As it is, all we can gain is mainly in the improved condition of the land. A farm with a family of boys that could do all the work might do very well. Then it would be a matter of interest on $15,000 in land and buildings, and not less than $2,500 in stock and tools. Am confident the silo affords the only hope of paying my expenses in running a milk farm in a village, on high prices for land, feed, help, etc."—*H. K.*

"If, as farmers, we wait for all objections to be removed, or objectors silenced, because convinced, before we leave the old beaten track for newer paths, we may wait until doomsday. There seems to be little so absurd, or unreasonable, but some cling to it as truth—no truth but what some will find objections. Hence, in the language of the good book, we must 'prove all things, and hold fast that which is good."—*H.K.*

"I am more than satisfied with my results, and shall continue to use the feed for both winter and summer. On my little farm of forty-five acres I am keeping thirty head of cattle and three horses, while three years ago it only kept one horse and eight head of cattle. Another season it will cut fifty tons of good hay and raise ensilage enough to carry through thirty to forty head of cattle, as there seems to be no limit to the crops that can be produced. I have now about ten acres of rye which I intend to put into the silos in June next, thereby having a crop to carry my cattle through until the corn comes round again. I might further say that I consider the corn crop the best to raise, and think that it will cause a larger flow of milk than the other crops, while it is not quite as nutritious as the oats or good rowen. I found that the silos were a convenient receptacle for the green crops, as my oats and rowen were both put in during wet weather, while my neighbours had a hard time in curing their oats and were not worth much for feed; mine was of the best quality, and all cut and put in in less than four days' time, making a great saving of labour and having the satisfaction of knowing that I had fodder that the cattle would clean up, and of much value. In connection it would be well to say that my fodder was cut by steam power, and the boiler is now utilized for the purpose of heating water for cows, hogs, and other purposes."—*H. R. Barker.*

"Mr. A. A. Reed urged farmers to beware of relying upon estimates, and gave some amusing instances of the mistakes made, even by conscientious old farmers, in guessing instead of weighing. During the discussion he also pertinently hinted that, though many of those present had abundant means to make expensive experiments, regardless of profit, they should remember that ordinary farmers must have the balance on the credit side of the ledger. The way to make the process prevalent was to show farmers there was money in it."—*Ensilage Congress.*

"It is to be regretted that so many extravagant statements have been made in relation to the value of ensilage—the number of cattle that could be kept from the product of a single acre, etc. Practical thinking men have been deterred from investigating this subject and giving it such attention as it really deserves, because of the wild statements of impractical enthusiasts."—*Prof. Samuel Johnson.*

"The claims made by many writers in regard to ensilage are extravagant; that it has certain advantages cannot be denied:

"First. Not more than fifteen to twenty-five tons can be depended upon per acre.

"Second. It is more certain as a crop than hay.

"Third. Twice as many animals can be kept on the same acreage.

"Fourth. It is largely a substitute for roots.

"Fifth. The labour of feeding ensilage is much less than hay.

"Sixth. The space required to store ensilage is not one-quarter that required for hay."—*J. B. Brown, in National Farmer.*

The Silo to be Cheaper.

"The general use of ensilage must depend largely on its cheapness. Costly silos and expensive machinery most always be insurmountable obstacles to a majority of farmers. For this reason, experience tending to show what is essential to the preservation of fodder in silos, is of the first importance.

"Especial attention is invited to the earth silos mentioned in the statement of Francis Morris, Esq., of Oakland Manor, Md. Mr. Morris is a pioneer in ensilage in America, his first silos having been built and filled in 1880. These were in the basement of his barn, walls of masonry. The next year he made a trench in sloping ground so that a cart could be backed in at the lower end for conveying ensilage in the feeding-room. The sides are sloping and the average depth does not exceed six feet.

"The cost is simply the cost of digging a ditch of similar dimensions. This trench was filled in 1877 and regularly since, and has kept its contents perfectly. Mr. Morris has several silos of the same kind, in different places, for convenience in filling. He uses a large cutter driven by a steam engine, and packs in the silo by treading with horses. The filling is carried several feet above the surface of the ground, and rounded up at the centre, the excavated earth serving to confine the ensilage. The covering is first roofing-felt, then earth for weight.

"Mr. Morris has put in whole fodder and it has kept perfectly. He cuts it fi , mainly for convenience in handling and feeding. Whole fodder should be laid across, rather than lengthwise in the trench, so that it can be taken out easily.

"In order that the extent of Mr. Morris' operations may be understood, it is proper to add that his estate of Oakland Manor comprises about 1,700 acres. His wheat crop this year, 1882, was 5,005 bushels, and his corn is expected to reach the same figures. The meadows yield upwards of 200 tons of hay annually. The stock consists of fifty horses and mules, 100 cattle, 500 sheep, and fifty hogs. And as the whole is managed on business principles, Mr. Morris very justly esteems his earth silos of primary importance."—*Editorial Remarks, in National Farmer.*

"Col. Le Grand Cannon has a large silo in South Burlington; Mr. H. N. Vilas has a wooden one—all that I know of in this vicinity, but more will be built this year."—*G. Morton.*

"Prof. Brown concluded from his experiments that there should be no difficulty in preserving this matter in an ordinary cellar, though he thought he himself had made a great mistake in not having the walls of the cellar smooth plastered, so that the boards (the cover) could be placed close to the walls and thus exclude the air."—*Brockville Convention, 1883.*

"However gratifying it is to me to see wealthy and intelligent men who have fine farms like Mr. Havemeyer's, whose silo I had the honour of assisting him in designing, adopting the system; the great and important thing is to show the millions of small farmers how they can adopt it—that there is no necessity for them to construct silos like Mr. Havemeyer's than there is for them to build a barn or a dwelling-house like his. The fact is that silos are the most economical structures for their capacity of any farm building. Silos are perfectly practicable of wood—aye, they are just as practicable as simple pits in the earth, provided the earth is of such a nature that it will not cave in, or so porous that the air can circulate through it. A wooden silo above ground is the cheapest; I have one at my farm in Virginia, which holds 150 tons. It cost me, for labour and materials, $50. I have a seventy-foot octagon barn; around it is a row of box stalls fifteen feet deep, which leaves an octagonal space forty feet across. In the center of this I built an octagonal silo twenty-five feet in diameter. I excavated in the solid clay seven feet and raised it with wood five feet; upon the edge I placed a sill four by twelve inches, spliced together at the corners. At the top I framed a plate four by seven inches in the same way; midway between sill and plate a girth was placed. On the inside one and a-half inch plank were nailed vertically; on the outside four by seven inch studs were cut in at the corners, and, midway between them, to these were nailed one and a-quarter inch plank, horizontally; the space between the plank was filled with clay.

"The silo was filled from the main floor of the barn; the corn was hauled from the field in dump carts, the stalks being loaded tops forward, which were backed up to the ensilage machine, where the loads were dumped. This way of hauling requires no handling except to feed into the machine—the cut forage falling through a trap door into the centre of the silo, where a man, a boy, and a horse spread it evenly and trampled it solidly. Athough the weather was exceedingly hot in September, while it was being filled, and for several weeks afterwards, in November, when it was opened, the contents were perfectly preserved. I am feeding a flock of sheep, twenty odd horses and colts, and a large stock of cattle and milch cows upon it, all of which are doing finely. I have colts at 'Winning Farm' which refuse the best of hay for corn ensilage.

"During my three years' experience with ensilage, and a somewhat extended correspondence with others concerning it, I have seen nothing, nor have I heard anything, which causes me to abate one jot or title of my faith that in ensilage shall the farmer find the boon which agriculture has sought from science in vain. Science has done wonders for manufacturing, mining, and commercial interests, but agriculture, aside from the progress caused by improved implements, has stood still. It is a humiliating fact that the average farmers in the older States pursue the same course and accomplish the same results as their fathers did. One thing which has deterred many from trying the system was the senseless iteration and reiteration that it was very expensive. Another objection, which was made quite a bugbear of, was the labour of weighting. The cost of silos, like most other things, can be made very large; so, too, they can be constructed at very little expense. There are hundreds of silos now built in haymows, in barns, many of which cost less than $25 each. I have heard from many, and they are universally successful. The cost of power and of machines for ensilaging can be borne by several, so that it will be light upon each. One set of machinery will answer for four farms very well. Corn is in the proper stage for ensilaging at any time after it is tasseled until the ears are fully formed. As to the last objection, the great labour of weighting and removing the weights, I will state that I do not use any weight whatever. I compress the ensilage by utilizing its own weight. The expense of the apparatus is not over two cents per square foot for the surface of the silo."—*Dr. J. M. Bailey.*

"It was in the summer of 1876 that I received a newspaper from France, giving me an account of what M. Goffart was doing. I realized the value of the experiment, and at once put several acres of land into corn fodder. My labour was blessed by a plentiful yield, and I built three silos of brick without cementing. The middle silo of the three had ensilage as good as I ever had. The loss on the sides of the other two was a small percentage, but sufficient to teach me that brick walls did not exclude the oxygen of the atmosphere. After this I covered them over with cement, and I find that they are now perfect. These silos I used for the first two years. Since then I have increased my acreage of corn fodder, and, with the assistance of a yoke of oxen and a scraper, dug out trenches eleven feet wide at the top, seven feet at the bottom, and seven or more feet deep. We fill these full, and then put as much as we can pile on it, and cover it with boards or earth. I always use a felt covering on the top of the fodder to keep it clean and the air out. We probably put twenty inches of earth on it, and we frequently run the oxen and cart over it. The top of the earth, or the top of the silo or trench, we watch, and if there are any cracks we fill them up. We exclude the air under all circumstances. These silos, or trenches, are made at a nominal expense, and the ensilage comes out in as good condition as any ensilage I have seen. My present practice is to put my trenches in the field where the corn grows. I would advise farmers not to be alarmed at the words 'silo,' 'ensilage,' or any other fancy words. Cut up your corn fodder into half or three-quarter-inch pieces, put it into your trenches, cover them with earth to exclude the air, and you will never fail to have a food better than any grass that you can raise for love or money."—*Francis Morris.*

"With 3,000 feet of common boards and twenty loads of sawdust, I have built a silo in one part of the haymow, fifteen by nineteen, that has preserved the fodder perfectly; and I have it where I want to feed it, close to my stock. My stone silo is twenty feet from the barn doors, and the difference in handling is at least one-half greater than from the wooden silo. Any poor farmer can build such an one, and it will answer the purpose

intended just as well as if he had paid out $1,000. The bottom of the wooden silo is cemented, after being banked up to the top of barn sills, using three barrels cement."—*G. Morton.*

"A pit can be made with little cost in ground where it is free from water, depending on the earth thrown out for the weight, and this piled up on the ridge, like a roof, and then covered with loose boards laid to break joints, with a few nails to hold them in place. Such a pit can be made by any farmer without feeling the cost. And, then, there is no doubt the cutting can be saved—only get on sufficient pressure by treading or packing, so you will only have to cut it as you take it out. This would answer where expense must be saved. Cutting fine as you pack is much the best for the ensilage."—*H. K.*

"A few years more of experience will enable us to improve in the selection and methods of handling crops for ensilage. I made a mistake the past season in putting in some rye. It was past using for feed—soiling. We cut it and packed it as well as we could, but it was so dry that on the top there was no fermentation; stock would not eat it. We dug a pit, removed it from the silo, and packed it in the ground, with more or less water, and fermentation softened it, so the stock would eat it readily."—*H. K.*

"I forgot to say that in my hurry some of the fodder came to the dirt silo uncut, full length. I rounded off the top with it, and it did as well as the cut. If I had to cut by hand I should try it uncut. I do not advise others; but if they did it so in Hungary eight years ago, that and my slight experiment would be my excuse for trial. I see no reason for farmers doing this if they do not wish to, nor can I see why each man should have a cutter and a power. If, as I believe it will, this work increases, why not men with portable powers make a business of doing it for the farmers? Here in the mountains I can cut at a water power and haul in a good grade just above my silo and dump down into it."—*Lewis M. Hatch.*

"The sense of the meeting was divided as to the best mode of preserving it, and in the construction of silos, which it was shown could be built with great cheapness and simplicity. It was shown perfectly preserved by two principles—the one by isolation, or the entire exclusion of air; the other by pressure. The best principle will soon resolve itself. There was also a difference of opinion as to the weight of crop grown upon the acre."—*Ex-Gov. R. M. Price, on Ensilage Congress.*

"Mr. C. W. Mills, of Pompton, N. J., one of the most successful ensilagists in the country, made an interesting statement, in the course of which he answered many questions about an independent discovery he claimed to have made in 1879, that renders the process of ensilaging cheaper than ever before. He abolishes pits built of stone or brick and lined with cement, the cost of which has frightened so many farmers. All that is needed, he claims, is a slight wooden frame, not necessarily air-tight, to prevent the spread of the ensilage crop when the weight is placed on top. Has two large silos, each forty by twelve and a-half and thirty-five feet deep. Should never build another, but simply curb up on the ground, which is gravelly. Puts on about 300 pounds of pressure to the square foot, the weight being gravel or sand in boxes three or four feet square. His plan is different from Goffart's; depends upon uniform and continuous pressure until the ensilage is used. The pressure he uses is sufficient to keep the air out of the sides of the crop, and the product is kept even better than in pits, where it is often bruised and battered until the succulent juices depart. He could sustain eighty milking animals six weeks on the product of five acres. His plan was to get the crop into the silos quickly, and cover immediately."—*Ensilage Congress.*

Testimony as to Profitableness of the System.

a. "Decidedly profitable.

b. "I wintered forty-three head of stock where I usually had thirty-five. Have sold $200 worth of hay and still have five tons left; but I am convinced that we have something yet to learn.

c. "Believe ensilaging the best and cheapest mode of preparing or preserving corn fodder.

d. "Am so well pleased with it that this year I have planted fifty-one acres of corn, and I hope to mix some clover with a part it, as I put it into the silo.

e. "If I had not a silo now I would build one as soon as possible.

f. "Must depend on circumstances. Where the silo is near the crop, I can't see how it can fail to be profitable. Even with the disadvantage of having the crop at a distance, I think I realize returns for all I expend, and more. It seems to me that chemical analysis reaches only a part of the whole question. The vital forces concerned in digestion are more important. A mere boy sees the connection existing between flush, tender pasturage and full pails of milk. Tell the boy that tender grass is little less than vapor, that such a large per cent. is water, easily procured at the brook, that such a small per cent. is ash, that the parts that go to make fat, and muscle, and butter, after the water is removed, are an insignificant amount, and he may stare and wonder at your learning, but you will fail to convince him that the dried grass is better for pasture than the fresh grass in the pasture. Let me add that a young child fed on the milk of an ensilage-fed cow has no irregularity of the bowels, is good-natured and grows finely.

g. "The most profitable food ever used. I made some experiments last winter in feeding a heifer, cow, mare with foal, weanling colt, and an old trotting horse. Cut timothy and clover hay, mixed in a large box with an equal amount of ensilage, adding a little corn-meal, coarse bran and shorts, and allowing the feed for the morning to remain over night, and again preparing in the morning for night. All were wild for their feed, and never left a spoonful to waste. A colt of the same age of mine, larger, and by many considered the best of the two, was fed from the time of taking up, in the old way, with hay given whole, and oats. This spring my colt looked like a two-year-old, compared with the other, and at less cost. The cow and heifer did equally as well. The old horse came out looking like a colt—his coat was never so fine as now, and the mare with foal never did so well before.

h. "For cows, steers, sheep and hogs it has been found, without exception, profitable; New England cannot do without it. It is a protection from draught in Nebraska and elsewhere; it is a safety from fire, grasshoppers and worms; and, more than all, is valuable in Texas.

i. "I consider ensilage profitable, and believe it is entirely healthy, taking the place of roots. It is easily digested, as is shown by the uniform temperature of the animals and the condition of the skin and hair.

x. "There is hardly a doubt expressed on this point—certainly not a dissenting opinion."—*National Farmer.*

"In reply to a question whether his farming paid, Col. Wolcott said he was keeping eighty cows, fed most of the year on ensilage, and sold his butter (a fine sample of which was on exhibition), at wholesale, for from sixty to sixty-five cents a pound, and the inquirer could judge for himself as to its paying."—*Ensilage Congress.*

"Rev. Dr. Ormiston had practised agriculture as a boy, and been a professor of it after leaving college. The paternal farmstead in Canada had been left him, and he came to the Ensilage Congress to learn about ensilage, after reading all he could get in print on the subject. He spoke earnestly on combining soul with soil culture, and said that though he should continue to preach theology on Sundays, he was liable to preach ensilage on week days. Thought the best way to spread a knowledge of the system would be to let the farmer know he could make money by the ensilage process—a matter of which he was satisfied."—*Ensilage Congress.*

Experiences and Conclusions of Pioneers in the New System.

"It is too soon to look for the sober, second thought about the matter; but aside from that, it is probably without a precedent that a new idea to the agricultural community has in so short a time been so widely tested, and with results so largely predominating in its favour. In my own collection of references to the subject in the agricultural press during the last eighteen months, I find sixty favourable testimonials from experience, against twenty other condemnatory or doubtful notices; and in justice to ensilage it should be observed that of these twenty writers only three have themselves tried the

method. The Agricultural Bureau, in response to a series of questions on the ensilage of fodder, gets from farmers in all parts of the country, who have tried it, eighty more or less hearty endorsements of the method, and gets nothing else. Dr. Hoskins, of Vermont, in whose word we all have confidence, says that eighty dairymen in that State have used ensilage for their stock with good results, and that the number of its adherents is increasing.

"It is idle to gainsay all this testimony from such a variety of sources, much of it accompanied with enthusiastic praise, whatever we may think as to the theory of the process. On the contrary we should be able to find some good reasons for the remarkable favour with which the system has been received; if we cannot, it must be feared that it is a delusion, that its profitableness is only apparent, and that its days will soon be numbered."—*Dr. G. C. Caldwell.*

"Doubtless all will concede certain indisputable facts; for example, that the ensilage system is the most interesting subject now presented for the consideration of agriculturists, because it promises more largely to lessen their labours, and increase their profits."—*Dr. J. T. Edwards.*

"The large number of silos erected during the last year in all parts of our country, indicates that ensilage has the sanction of a number of our leading farmers, and that actual tests confirm reasonable claims as to its value as a cattle food. The farmers of Great Britain, too, are greatly interested in this subject, and it has received the favourable attention of some of the leading English agriculturists."—*Prof. Samuel Johnson.*

"It is my experience that I can keep three times as much stock upon a given area of land by curing the forage in silos as I can by drying it. The experience of every one who has tested the matter substantially agrees with mine. Winning Farm, which three years ago could sustain but six cows and one horse, now can sustain forty head of horned cattle, eight horses, fifty sheep and between fifty and sixty swine. During this time I have purchased no hay or manure, excepting about a ton of commercial fertilizer, which I use in drilling my corn, I feed no more grain per head than I did when I fed hay or dry forage.

"Horace R. Barker, of Lowell, Mass., tells us that he is keeping three times the stock he could keep if he depended upon dry forage. He feeds his milch cows each six quarts of wheat bran daily, and they are all fat enough for beef. Capt. Marsh, the Superintendent of the Massachusetts State Almshouse, says he will save nearly enough this year in hay to pay the entire expense of building the silos, although from the excessive drought, and because his corn was planted too thick, his silos were but half filled. Their capacity is about 800 tons. Daniel Stratton, of Hudson, a life-long practical farmer, says, after feeding ensilage one winter:—I have sold hay enough to pay the entire cash outlay for silo and machinery more than I could have sold, besides wintering more stock than I wintered before. I had rather part with half my farm than my silos could I not build another, for upon half the farm and good silos I can keep 100 cows, while upon the whole of it I can keep but forty head without a silo.

"E. C. Fisher, of Claremont, N.H., writes me: 'I planted two and a-half acres of old bound-out field, which would not have cut over 500 pounds of hay to the acre, using one bushel of seed, and applying twenty-five dollars worth of Stockbridge corn manure in the drills. Upon that piece of land I gathered sixty tons of corn fodder. I arrived at the weight by carefully cutting out a cubic foot of ensilage about half way from the top to the bottom, and multiplying that by the number of cubic feet of ensilage in the silo. I fed twenty cows upon the ensilage for eighty days, with the same grain ration I had been feeding with the best of hay. In less than a week there was an average gain of one quart of milk per day to each cow. I was milking sixteen; the four dry ones were fed no grain whatever, and did better than I ever had cows do upon hay alone. I tested the quality of the milk by making one pound of nice, yellow butter from nine quarts of milk, using for this purpose milk I chanced to have left after supplying my customers. My cows are natives, and not selected for their butter-yielding qualities, but rather for giving a large quantity of milk.' As he is a milkman, it was hardly necessary for him to say this. To keep twenty cows eighty days is the same as keeping one cow 1,600 days, or nearly four and a-half years. Will any scientist claim he can take two and a-half acres

of average New Hampshire land in the condition this lot was, and by applying twenty-five dollars worth of chemical manures, keep a cow four and a-half years upon the product of a single season cured by drying? This man has the past season built another silo, and is now feeding ensilage the second winter. I might occupy the time until night by relating the experience of hundreds of practical farmers who have written to me of their success. Of all who have tried the system not one has met with failure, or who is not more firmly convinced of its great benefits. Hon. Benjamin P. Ware, who constructed a silo during the past season, says he believes six or seven cows can be wintered from the product of one acre by the system of ensilage."—*Dr. J. M. Bailey.*

"Yours of the 10th inst. is before me. This is my third year in using ensilage, and I like it better than ever. I should say the stock show by their looks that they like it better and better. This farm is the old homestead, where my wife's father (one of the most judicious farmers in the State) lived and farmed for fifty-five years, and the best he could do was to keep seven cows, and this year, feeding nothing but ensilage, I shall winter (and feed them well all they will eat) eight cows, six two-year-olds, seventeen large calves, four hogs, and three shoats, using no hay or grain until after the cows come in, when I shall cut and feed hay and straw, mixing, as I did last season, one-tenth meal and bran.

"I am of the opinion that ensilage will revolutionize farming in New England. Scientists may say what they please about its all being water, but they cannot argue against facts. When I commenced feeding ensilage, on the first of October, I had fed during September alone two tons of meal and bran; I stopped feeding that and fed only ensilage, and the cows gained one-quarter and one-third on their milk. They had the same pasture as before; the change of food kept them perfectly healthy. Visitors (old farmers) who know what they are talking about, say those cows are the finest-looking that they have seen this winter. Now these are simple facts that you cannot wipe out. It is all nonsense to talk about enthusiasm. No man can look at such cattle and see their happy faces without being convinced. I have done more writing in the two past years than I ever did before in my life. Letters come from Florida to Quebec, Canada, asking the same questions over and over a thousand times. I answer them, because I believe in so doing I benefit my brother farmers.

"An old sea captain—how did I learn to take this step in advance? By reading the agricultural papers and going on the American progressive principle, that what one man does another can. I stopped using tobacco for one thing—had used that forty-five years—and quit cider. Farmers say they cannot afford to take papers, and right here in this town they drink enough cider and use enough tobacco to build a silo on every farm. I have done talking to these Bourbons; when they get ready they will build silos. They will have to do it or starve."—*G. Morton.*

"I resolved to build a small silo in my barn as an experiment; but upon further consideration decided to visit Massachusetts for the purpose of investigating the system, and gaining a practical knowledge of the subject. Early in April I visited several farms near Boston.

"After what I saw and learned during this tour of inspection I abandoned the idea of an experimental silo, feeling confident that the benefit to be derived from the ensilage of green crops was an established fact. I accordingly built a permanent silo adjoining my stables, of brick and concrete, fifteen by thirty, and twelve feet deep. Into this we put the corn from three and a-quarter acres of light, sandy land, manured broadcast, and planed in drills three feet apart. A portion of the crop we estimated, by measuring and weighing, to have grown thirty tons per acre. We used No. 15 cutter geared three-eighths inch, with a two-horse railway power, connected with a shaft inside the building over the silo, which enabled us to put the power at the end of the silo, out of the way. This added much to the convenience of unloading the corn near the cutter from the dump carts which we used in preference to wagons. The feed was tramped in the silo only sufficient to level it off occasionally. Covered with two-inch plank, laid directly on the corn, and weighted with less than one foot of stone. This settled five-twelfths.

"In addition to the corn, we ensilaged some six or eight tons of second growth clover which was cut and put in during a rainy day. It is all turning out in excellent con-

dition. We have fed about thirty head of cattle, about once a day, since the 20th of November from the silo, the balance of their feed being dry hay. I should except six steers and heifers which we have fattened on an additional ration of shorts and corn meal. Our cows *doubled* the quantity of their milk in a few days, and have not decreased up to the present, notwithstanding some of them are forward with calf. The whole stock are thrifty, and look better than had they been fed entirely upon hay. The corn next the plank covering turned dark; but there has been no waste to speak of, the cattle eating it all.

"This year I expect to crib the silo four or five feet above the wall with boards, so as to have it nearly or quite full after settling, thus adding to its capacity. If another winter's feeding proves as satisfactory as this beginning, and with the increase of stock and manure, I shall probably double the capacity of my silos. Of course, I have met with what every pioneer in this new dispensation has had to contend with, viz., the *sneers* and *prophecies* of the *knowing ones;* but he 'laughs best who laughs last.' I have kept a larger stock than ever before, and shall have at least one-quarter of my hay to sell (heretofore I have required all I could make), besides selling $500 worth of beef. On the other hand, without ensilage I should be no better off than my neighbours, who have been unable to make beef owing to the high prices of feed. I hear of several who contemplate building silos this season, and some of those were the most sceptical."—*C. R. H. Starr*

"The Congress very appropriately concluded its two days' session by adopting a resolution declaring, That it has become a well established fact, by six years successful use in this country, and by the concurrent testimony of many farmers, that the ensilage system is of great advantage to agricultural interests, as to all mankind." — *Ensilage Congress.*

"The practice of ensilage is rapidly spreading, and undoubtedly it will spread more the more its advantages become known. There has not yet been a case known in which the practice has been abandoned, and a silo diverted from its intended use. Thousands of practical farmers are using silos, and as they are gaining experience in growing the crops and in feeding the preserved fodder, they are better satisfied with the results of their venture. The agricultural professors who have experimented with it have spoken favourably of it, and the students who have seen it practised in the best manner will, in course of time, make use of it upon their farms, which will become new centres for its enlargement. The experience of the past season are all favourable."—*Agricultural Paper, 1883.*

Possibilities in the System..

"You will observe the proportion in this case is substantially ten head of stock to each acre for a period of between seven and eight months, so far as the ensilage fodder is concerned. Mr. Mills expects to increase this proportion, and not to send his cattle to pasture at all hereafter. He will ensilage winter rye in June, then plant corn, to be saved in September, thus making two crops per year, which will enable him to carry from eight to ten head of stock to an acre the year through."—*Boston Herald, on C. W. Mills' Farm.*

"Now, my simple proposition is that all the arable lands of this State should be divided into two parts—one part in corn fodder and the other part in the present uses the land is put to. This would give us 7,800,000 acres of corn fodder, which, at ten tons to the acre, would amount to 78,000,000 tons, which would pay the farmer $100 per acre for his crop. The value of the crop in this State, at the price named, would amount to $780,000,000, and this would be represented by oxen, cows, sheep, butter, cheese and milk. I cannot think that the land would bear less than ten tons of corn fodder to the acre—and perhaps double that—and every farmer with 100 acres of corn fodder would have the representation of $10,000. It would be his business to turn his corn fodder into stock, or butter, or cheese—and, so long as beef, mutton, butter and cheese, hold their present prices, his income should be $100 for his land per acre in corn fodder."—*Francis Morris.*

According to the Census Report of 1870, there were 218,250 farms in the State of New York averaging 103 acres. The value of the productions of said farms was over

$250,000,000. There is no conceivable reason why one-half the land of some farms should not be put to the raising of corn fodder quite as fast as they can procure stock to eat it up, and then the profit of this system will be as large as named, until we become our own rivals by our success of production."—*Francis Morris.*

"We are living in an age of great progress, but I know of no discovery fraught with such grand results as the preservation of green fodder throughout the year. The economy is wonderful, and from what I saw at the meeting referred to, I feel confident of its entire success, and that dessicated fodders will soon become obsolete and a thing of the past. From its great cheapness of preservation it will spring into general use at once, and quadruple the production and receipts of the farm. The cost of 'silos' and the putting down of fodder 'ensilage' can be done at less cost than the present mode of drying—the one method evaporating the nutritive qualities, and the other preserving all in a succulent condition. What a wonder the world has been going on in such a method so long, with such an enlightened people! How slow we have been. It must prove a greater boon in its practical results than anything invented or discovered during this Christian era—enriching all alike, the poor and the rich. While increasing the food supply it will diminish the cost to the consumer."—*Ex-Governor R. M. Price, on Ensilage Congress.*

"I had no idea so new a system could have been so soon perfected, but experience, experiment, and chemical laws applied have done it. I feel, personally, a great deal of pride, being one of the earliest believers of the system, as I now feel assured it is an accomplished fact, for I feel that ensilage will prove the planted acorn which will grow into the mighty oak, and overshadow the earth with prosperity, plenty and happiness."—*Ex-Governor R. M. Price.*

NOTE.—The authorities quoted by the *National Farmer* are as follows:—H. E. Brown, Thetford Centre, Vt.; Samuel Adams, Coldbrook Springs, Mass.; E. Allen, New Brunswick, N. J.; W. B. Benson, Cardinal, Canada; John P. Bent, Maynard, Mass.; Otis Bisbee, Poughkeepsie, N. Y.; J. B. Brown, New York City; Colonel Le Grand B. Cannon, Burlington, Vt.; D. Bookstaver, Syracuse, N. Y. The other authorities quoted on ensilage are located as follows:—G. Morton, Vermont; Dr. J. M. Bailey, H. R. Barker, W. A. Foster, and Col. J. W. Wolcott, Massachusetts; Samuel Remington, Hon. O. B. Potter, W. M. White, W. R. Strong, and Dr. Ormiston, New York; Ex-Gov. R. M. Price, E. Wright, and C. W. Mills, New Jersey; A. A. Reed, Rhode Island; C. W. Garrett, and Lewis M. Hatch, North Carolina; Francis Morris, Maryland; C. R. H. Starr, Nova Scotia; Mr. Pierce, Quebec; Prof. Brown, E. D. Tillson, and James Harris, Ontario.

ONTARIO GOVERNMENT ACTION.

Provincial Treasurer and Commissioner of Agriculture.

"Mr. Rolls, secretary of the meeting, read from the last official speech of the Commissioner of Agriculture to show that in the opinion of Hon. Mr. Wood the 45,000,000 pounds of butter manufactured in Ontario in 1881 was of a much inferior quality—an unpleasant fact." (*Toronto Globe* Report of W. H. Lynch's Address in Board of Trade Rooms, Oct. 18th, 1882.)

Prof. Buckland, Ontario Agricultural Department.

"The chairman (Prof. Buckland), in his opening remarks, said that the subject was a very important one, and the Commissioner of Agriculture would have been present had not engagements previously made prevented. If suggestions could be made that would enhance the dairy interests of the country, the Government would no doubt give every encouragement." (*Toronto Mail* Report of W. H. Lynch's Address in Board of Trade Rooms, Oct. 18th, 1882.)

G. M. Rose, Esq., President Toronto Board of Trade.

"Mr. Rose, the president, then closed with a few practical remarks, showing the importance of the dairy interests to the Province of Ontario and the Dominion at large, and urging both the Government and the people to encourage and support the proposed reform in the manufacture of butter." (Extract from Official Minutes of Meeting of Toronto Board of Trade, Nov. 1st, 1882, addressed by W. H. Lynch, by invitation.)

Report of Committee of Agricultural and Arts Association.

"We are thoroughly agreed with Mr. Wood that the subject is one of great importance to the people of this Province, and would justify any reasonable expenditure for such a purpose." (*Toronto World*, Dec. 16th, 1882.)

Letter of Henry Wade, Esq., Secretary Agricultural and Arts Association.

"The only question about which there could be any difference of opinion was as to the best method of carrying out so desirable an object. One plan is that suggested by the Hon. Mr. Wood, viz., the establishment of creameries where instruction could be imparted free of cost to all who chose to attend. Another scheme would be the employment of an expert to travel through the country educating the people upon correct principles of dairying, and giving practical instruction. . . . Now, the fact is that the opinion of the council was unanimously in favour of the Government making an attempt to improve the manufacture of the butter made in *the private dairies* of the Province." (*Toronto Globe*, Dec. 16th, 1882.)

Prizes offered for Essay on Improvement of Quality of Butter.

"The Agricultural and Arts Association of Ontario offered two prizes for an Essay on the 'Best and most practical means of improving the quality of butter in Ontario, both as regards its manufacture in private dairies and creameries." (*Globe*, Dec. 16th, 1882.)

Petition to the Hon. O. Mowat, Premier of Ontario, signed by 54 leading men, representing the following: Commission Merchants (18), the Press (18), Corn Exchange and Board of Trade (11), the Grange (2), and citizens of Toronto.

SIR,—In view of the importance of the butter industry of this Province, and the generally admitted need for improvement in that industry, we, the undersigned, desire respectfully to call your attention to the efforts lately made by W. H. Lynch to awaken a public interest in the subject of Scientific Butter-Making, and ask your Government to investigate the matter, with a view, if possible, to sanction and encourage the movement.

General attention has been called to the butter question by the public exhibition of new scientific butter-making utensils, and by several public addresses upon the subject. Reports of the result of experimental tests of improved utensils go to show that the introduction of proper appliances will perhaps do more than any other one thing suggested to bring about the desired improvement.

We believe a condition of early improvement to be a change in the present methods of butter-making in the private dairies of the country, involving the introduction of better appliances than are now in common use; and that the introduction of suitable appliances is itself the most likely agency to improve the existing state of things.

We believe, further, that the educational work which is involved in the supplying of new and improved utensils would be a charge that ought not to be wholly borne by private enterprise, and that it stands more or less in the way of such enterprise.

This being true, it would appear that it would be in the public interest, for the Government, in its attempt to bring about a reform in the butter industry, to associate its efforts with the work of such private enterprise as would give promise of producing the desired results; and we strongly recommend Government co-operation with enterprise of citizens.

G. MacLean Rose, Pres. Board of Trade.
W. Pemberton Page, Ed. *Canada Farmer.*
Christie, Brown & Co., Biscuit Mfrs.
Daniel Rose, Ed. *Colonizer.*
Sarah A. Curzon, Assit. Ed. *Citizen.*
Avern Pardoe, Ag'l. Ed. *Toronto Globe.*
E. H. Dewart, Ed. *Christian Guardian.*
J. K. Kerr, Blake, Kerr & Cassels.
James Hedley, Ed. *Monetary Times.*
Joseph Wild, Bond St. Church.
E. A. Wills, Sec. Tor. Corn Exchange.
Wm. J. Walton, Farmer.
Jessie McEwan, Pres. Women's Literary and Social Progress Club.
Jennie Gray, Sec. do., do.
Emily F. Lovell, Member do., do.
Emily H. Stone, Member do., do.
Jas. White, Rose Avenue.
N. Mathers, Isabella Street.
J. D. Laidlaw, Commission Merchant.
R. H. Ramsay & Co., "
J. Goodall, "
Davison, Scott & Co., "
Francis Gallow, "
Wm. Monteith, "
J. L. Kavanagh, "
Hawley Bros., "
James Park, "

J. Rolls, Sec. Board of Trade.
Ed. Trout, Man. *Monetary Times.*
Robertson Bros., Confectioners.
Wm. Burgess, Ed. *Citizen.*
J. W. Bengough, Ed. *Grip.*
O. A. Howland, Advocate.
J. Ick Evans, Financial Agent.
J. F. McCuaig, Ex-Inspector.
E. B. Biggar, Aux. Pub. Co.
J. B. Cameron, Minister Pres. Church.
Swan Bros., Grocers.
W. H. Harris, Man. Grange Wholesale Supply Co.
A. B. Hamilton, Manufacturer.
James H. MacLean, *Toronto World.*
M. F. MacLean, "
W. H. Withrow, *Methodist Magazine.*
J. J. Withrow, Manufacturer.
Jno. D. Nasmith, Baker.
Jno. MacLean, Ed. *Can. Manufacturer.*
Patrick Boyle, *Evening Canadian.*
E. P. Roden, *Toronto Mail.*
C. W. Buntin, Man.-Dir. *Toronto Mail.*
J. Ross Robertson, *Evening Telegram.*
William Ryan, Commission Merchant.
D. Gunn, & Co., "
Robt. Thompson, "
Robt. Shields & Co., "

Memorandum accompanying Petition to Mr. Mowat, Premier of Ontario.

"As to the means of improving the dairy industry, suggestions have been made in two directions: First, that creameries be established; and, second, that better utensils and methods be introduced into the private dairies. It is claimed that if creameries were to wholly replace the dairy *as it is*, the product would be of a higher average quality than it now is. But it is also generally believed that the private dairy must continue to exist, and to so great an extent that no remedy of the bad state of the industry will be complete that does not carry reform into the dairy."

Proposition made by W. H. Lynch to Ontario Government.

"That the Government distribute to farmers a Manual on Scientific Butter-Making in Private Dairies. That the Government appropriate $10,000, to be divided into two equal amounts, and each amount be expended as follows: $5,000 in the purchase of complete outfits for making good butter in private dairies, and $500 be employed for instruction in the use of the improved appliances; that with the balance, one creamery may be established at a central point for general instruction in the art, etc. This would do for experiment, leaving one half of the sum voted by the Government, or $5,000, to be used as the result of the experiment would indicate or warrant."

From Toronto World.

"Some two months ago Mr. W. H. Lynch, of Danville, eastern townships, Province of Quebec, came to Toronto to try what he could do in the way of interesting influential people here in the question of how best to improve the quality of butter made in this Province. He exhibited in one of our corn exchange rooms samples of churns and other appliances for which he has the patents, and proved before competent judges their efficiency for the operation of making good butter with certainty and convenience. *Mainly as a result of Mr. Lynch's visit*, we believe the matter has been taken up by both the Provincial Government and the Agriculture and Arts Association. The Government is willing to put something in the estimates for the purpose, if only some satisfactory plan can be matured; and $10,000 has been mentioned as the sum which might be voted to begin with. The advice of the association has been asked in the matter, but that body has not yet taken the responsibility of officially making any specific recommendation."—*Toronto, Dec. 20th, 1882.*

Many other extracts might be given, but space will not permit. The press and leading men, and the best authorities are all committed to the opinion that there is need of improvement, and that Government has in this connection an important work to do.

AUTHOR'S LAST WORD.

It is due to the writer for him to state that some at least of the faults of this *Manual* are due to the circumstances under which it was written. He was first limited as to time, having been allowed but one month in which to write. The time was afterwards extended, but what was added from time to time was added piece-meal, and without knowledge of the limit as to space. The calls for copy are often at a time when absence from home, and business engagements, forbid full justice being done to the subject. In a word, had the whole book been written under a little less stress of circumstances, before any of it had been given to the printer, there would have been fewer imperfections in the work. Some improvement may be looked for in another edition, for which there is already a call.

Having done with apologies that are as disagreeable as necessary, I may take up that which is even more of a pleasure than a duty. I am glad to give expression to a sense of obligation to many workers in this special branch of agriculture, among whom I may mention the veteran and genial Arnold, the late and esteemed Willard, also Professors Harris Lewis, Wetherell, Sheldon, Jocelyn, and last but not least, Professor Brown, of Guelph.

W. H. L.

ERRATA.

Page 50, ten lines from top, "manufactured" should be "manufacturer."
Page 102, second heading, "Qualtity" should be "Quality."
Page 145, sixteen lines from top, "Sheldon" should not appear.
Same page, 20 lines from top, "Containing it" should be "Containing Milk."